Lauer's Method of Submarine Blasting.

TRANSLATED FOR ENGINEERING NEWS BY GEO J. SPECHT, C. E.

Major J. Lauer, of the Austrian Corps of Engineers, has successfully used the following method of submarine blasting:

His plan is to blast under water by cartridges laid loosely on top of the object to be removed, by means of guide-rod; electricity to be used in firing the charge. The apparatus is quite simple, consisting of a frame-work fastened to the stern of a common scow

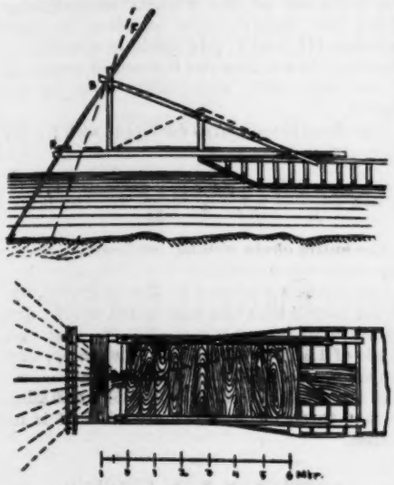


FIG. 1.—BLASTING SCOW.

(Fig. 1), and extending beyond it. At a short distance from the outside end of the frame the are two uprights connected by a cap to middle of which the guide or sounding rod is pivoted by a pin. Upon the frame is another which can be moved back and forward on the lower one. On the end of the upper frame there are two horizontal timbers connected together by bolts at every foot: the guide-rod works in the space between the bolts.

The guide-rod is a gas-pipe 40 mm (1.6 in.) diameter, at the lower end a ring or a short piece of pipe is fastened, into which either the sounding rod or the cartridge rod is placed. A chain connected with the lower end of the rod enables it to be lifted. The sounding rod being moveable, it can be raised or lowered so that a larger or smaller area can be examined; and as the cartridge is set by the same rod, the same area can be sounded and worked without changing the position of the scow. The soundings obtained are all measured on the slope of the inclined rod, these can easily be reduced to vertical distances. The manipulation of the apparatus is too simple to require further explanations.

The first trials were made upon a rock in the Danube, near Krems; it was gneiss rock with seams of quartz. The depth of water changed during the experiment from 8.9 to 10.8 ft., and the average velocity at the surface was 10½ ft. per second. In the face of these difficulties the work was successfully accomplished in 9 days or 60.6 actual working hours.

In 9 days the actual time consumed was 60.6 hours; the average work per 10 hours was 350 soundings and 72 blasts, each sounding taking 25 seconds, and each blast from 4 to 5 minutes. Altogether 399 blasts were fired, and with 295 lbs. of dynamite about 43 cu. yds. of rock were removed. The current carried away the blasted material. The cost was about 12 florins per cu. metre, or $3.80 per cu. yd.

This method can be employed in very deep and rapid rivers as well as in shallow and sluggish ones, and at a cost far below that of other systems. While the removal of submarine obstacles by drill-holes, drifts, shafts, etc., is perhaps more effective as covering greater areas, the advantages are somewhat neutralized by the expense of removing the large masses of rock.

Division of Land on the Canadian Pacific R. R.

The system of survey and laying out the land throughout the north-west is so simple and complete that really it leaves nothing to be desired, as every farm of 160 acres is at once identified without difficulty or delay. It was no small matter to lay out a country the size of Europe so that each spot should have an individuality, and be capable of immediate recognition. Like many others of the Canadian systems, it is an improvement upon and an amplification of a system that had been thoroughly tested in the United States, and the improvements were principally in the details. Two initial lines, one due east and west and the other due north and south, were chosen to commence with, and the lines of latitude and longitude at once offered the necessary data. From the Lake of the Woods to the Pacific the 49th degree of latitude is the boundary between Canada and the United States for 1400 miles. In 1826 this line was run by a joint commission of the British and United States authorities, was carefully chopped out where brush or forest intervened, and after the center line had been determined by astronomical observations, cairns, iron pillars, earth mounds, and timber posts were erected at intervals along it. A stone cairn is about 7 ft. by 8 ft., and in lakes or swamps these were built up till they were sufficiently high to form a guide; in some places they are founded in 18 ft. of water, and they are always carried up so as to be 8 ft. above the highest water mark. The earth mounds were 7 ft. by 14 ft. The portion east and west of the Red River is marked by iron pillars, of which there are 382 between the Lake of the Woods and the base of the Rocky Mountains. They are placed at even mile distances, the British placing theirs every 2 miles and the United States the intermediate ones. They are hollow iron castings in the form of a truncated pyramid 8 ft. high, having at the top a solid pyramidal cap, and at the bottom an octogonal flange. Upon the opposite faces, north and south, are cast in letters 2 in. high, on one side, "Convention of London," and on the other "October 20, 1818." One of these iron posts can be seen at the head of Main street, Emerson, whilst at West Lynne several, both of wood and iron, are in sight. This line is the first base line of the new survey, and every 24 miles from this is another base line, known as the second, third fourth, and so on. The first north and south meridan, called the first principal meridan, is in west longitude 97 deg. 30 min. from Greenwich, and passes about 10 miles west of Winnepeg. The 102 deg, is the second, the 106 deg. is the third, 110 deg. the fourth, and 114 deg. of west longitude, the fifth principal meridan.

Starting from each of the principal meridans, the surveyors run lines parallel to the base lines from one principal meridan to the next, marking off every sixth mile along a line intermediate, that is 12 miles from each base called the first, second, and so on, correction line. Thus an intermediate line between each base and each correction line, and vertical lines parallel to the meridans, divided the whole into blocks 6 miles square, which are called townships. These townships are numbered from one upwards, going north consecutively, and are marked in the maps in ordinary Arabic figures. The "ranges" number from the first principal meridian west, going towards the west and east, for those to the eastward are marked in Roman figures on the map. Remembering that the townships are exactly 6 miles square, it is of course easy at once to identify pretty nearly the situation of any one when the range and the township are given. Thus the middle of the tenth township in the nineteenth range, being the one in which Brandon is situated, is 17 miles north of the boundary, and 117 miles west of the first principal meridan, that is, 127 miles west of Winnepeg, taking its central point. Moose Jaw, between the sixteenth and seventeenth township, that is on the line between them and on the twenty-sixth range west of the second principal meridian, is 156 miles west of the 102nd parallel, and 96 miles north of the boundary. The townships being set off 6 miles along each of the base lines, at each of these correction lines there will be a jog corresponding to the difference made in 24 miles in the length of the parallels of latitude, so that, say in the second or third base line, the lines between the township, north and south of the correction line, will not be opposite to each other, and so whilst there are nearly thirty-four full townships between the first and second principal meridians on the first base line, there are not quite thirty-three on the fifth, and fewer still as the survey is continued further north.

North.

	31	32	33	34	35	36
	30	29	28	27	26	25
	19	20	21	22	23	24
West						East
	18	17	16	15	14	13
	7	8	9	10	11	12
	6	5	4	3	2	1

South.

The townships themselves are divided into 36 sections each one mile square, and uniformly numbered as in the above diagram, beginning at the south-east corner, and counting backwards and forwards consecutively to the north-east. In all these townships Nos. 11 and 29 are reserved by the Government for school purposes solely, whilst Nos. 8 and 26 belong to the Hudson's Bay Company. Each section is again subdivided into four quarter, each having 160 acres of land. The even numbers throughout, excepting the two lots mentioned above, are reserved by the Government for homestead and pre-emption claims, whilst all the odd one, within a certain distance of the Pacific Railway, are given to the company as part of their land bonus. Throughout the Qu'Appelle Valley, and in other parts, the Canadian Pacific have sold to the North-West Land Company six out of the fourteen sections originally given to them, so that in these townships:

Nos. 2, 4, 6, 10, 12, 14, 16, 18, 20, 22, 24, 28, 30, 32, 34, and 36 are open to settlement under the Homestead and Pre-emption Laws;

Nos. 1, 9, 13, 21, 25, and 33 are sold to the North-West Land Company;

Nos. 3, 5, 7, 15, 17, 19, 23, 27, 31, and 35 belong to the Railway Company; whilst

Nos. 8, 11, 26, and 29 are reserved for the Hudson's Bay Company and for school purposes.

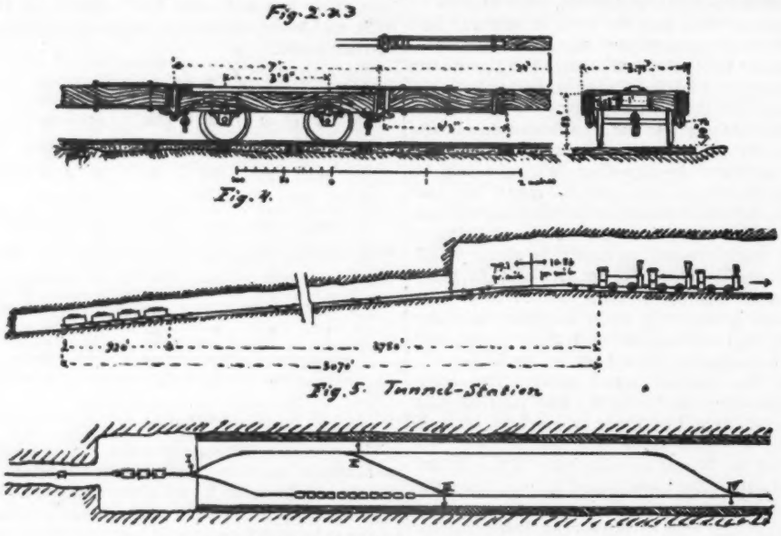
The lands under the Homestead Laws, belonging to the Government, are offered as a free gift to intending settlers, a homestead, that is a quarter section 160 acres, being obtainable on condition of cultivation and actual residence for three years, and on payment of 10 dol. (2l. sterling) for entry certificate. Settlers taking advantage of this offer, and who wish for a larger farm, can secure a pre-emption of an additional 160 acres without the payment of anything except the entry fee; the whole 320 acres, however, must be cultivated for three years, and the conditions of the homestead grant must be faithfully car-

ried out. All the other arrangements and conditions are made in the most liberal spirit to the actual settler, and are so far only restrictive that they are intended to prevent, as far as possible, speculation in lands for the securing of large blocks for the purpose of keeping them up from actual settlement and cultivation, or to hold them in idleness for future sale.—*Engineering.*

Chain-Transportation in the Arlberg Tunnel.

Translated for ENGINEERING NEWS by GEO. J. SPECHT, C. E., from the paper by PROF. FR. R. VON BRIKA, Proceedings of the Austrian Society of Civil Engineers and Architects, Dec. 22, 1883.

The contract for the construction of the Arlberg Tunnel contains the clause that the tunnel must be completed, i.e. ready for regular traffic, 180 days after the two advance headings are connected. This was a severe



SYSTEM OF CHAIN TRANSPORTATION.

demand compared with the Mont Cenis Tunnel, which was completed one year after the meeting of the two headings; and with the St. Gotthard Tunnel where it took two years to finish.

The unprecedented rapid progress of the advance headings made the fulfillment of this condition still more difficult, as all other work had to follow at the same rate. But it can be said with certainty that the entire work will be finished in the time fixed.

This is a grand achievement and is due to a well devised and strictly carried out system of working. The different points of attack followed at fixed distances, and the length of tunnel including these is called the "working section" of the tunnel. The number of working places n depends upon the progress made in the bottom heading and its relation to the progress in other places.

We have the formula

$$n = s\left(\frac{1}{5} + \frac{1}{2f} + \frac{1}{v} + \frac{1}{m}\right)$$

when s, f, v, and m stand for the progress made in the bottom heading, in the top heading, in the enlargement and in the masonry respectively; if $s = 3.5^m$, $f = 0.8^m$, $v = 0.24^m$ and $m = 0.4^m$, $n = 41$; i.e., that there must be 41 working places to allow the work of completion to follow the advance heading at an equivalent rate of progress. In fact, in the last months before the connection of the headings, the total length of "working section" on either side was 4,600 ft., in which distance there were under construction seven sections top heading, twenty-three enlargement and thirteen arch sections.

In reference to the transportation Mr. Brika says, that with a daily progress of 18 ft., ten trains passed each way, each consisting of seventy-five cars. The in-going train usually had forty-eight empty rock-cars, twenty loaded stone cars, five flat cars loaded with lumber, rails, tools, cement, etc., and two cars with sharpened drills. The out-going train consisted on an average of forty-eight full rock cars (2.6 cu. yds. each), of twenty empty stone cars, five loaded with old lumber, empty barrels, tools, etc., and two cars with dull drills. The so-called "full" out-going train weighed about 250 tons, and the "empty" in-going train about 142 tons.

The total weight to be transported over a track of 28 in. gauge, each day, is therefore $10\,(250+142) = 3920$ tons; an amount which exceeds that transported in the largest mines out of one opening.

The moving of this large mass was only made possible by great method in arrangement and punctuality. All the trains were run according to a fixed time-table, the first time such a plan was ever adopted in tunnel-work; the scheme was a great success, one section forcing another to keep its proper place in the schedule. This method of transportation admirably served all purposes until the apex of the grade was passed, when other plans had to be adopted. It might be mentioned here, that the in-going trains were arranged and loaded outside in accordance with written orders, sent out from the various sections, giving the number of cars and kind of supplies wanted.

As soon as the East-heading passed the summit another system of transportation was adopted; the usual rope-ways, employed in mines, were found impractible, so Mr. Ceconi, one of the contractors, devised a system which was cheap and simple and fully answered all purposes. It consisted of a stiff chain running on wheels, which was *pushed* into the working section by the locomotive and pulled out again after the filled cars were attached to it. This chain (Fig's. 4 & 5) is made of a number of small flat-cars, which are connected with each other by sticks of timber, 25 ft. long and 4½ in. × 8½ in. in section. The chain is thus sufficiently flexible and yet stiff enough to be pushed into place by the engine.

The manipulation is as follows: At the end of the finished tunnel-section, a "tunnel-station" is arranged of such length that the whole chain can find room on the side-track in front of switch II. If cars are to be hauled from the working section, a locomotive pushes the chain through switches II. and I. into this section, when the loaded train is coupled on to it; meanwhile two other locomotives pull the in-coming train from the outside to the "tunnel-station" and put it on the side-tracks III.-I. While this is going on the first engine has pushed the train *towards* the working-face and has passed switch I., then the two locomotives, just arrived are coupled to this engine and together they pull out the train, including the chair, on an aggregate 4600 ft. long. The engines run on the track I., II., IV. and leave the chain between II. and IV. One of the three engines then runs empty out of the tunnel and the other two return by switches IV., III. and II. to the loaded train and pull out to the dump. The brakesmen, who came with the train out of the working section, now board the empty train, standing between switches III. and I,, and guide it down to the working places, they run it down in groups of a few cars each, controlling them by the brakes.

The three locomotives develope, with 176 lbs. pressure, tractive power of

$$Z = 3\frac{0.6\,p\,d^2\,l}{D} = 3\,\frac{0.6\times 12\times 23^2\times 30}{53} = 9510 \text{ kilos.}$$

The entire chain weighs, per *metre*, 52 kilos., (one foot = 35 lbs.)

The resistance offered by the out-going train of 231 *metric* tons (252 tons) gross weight, and by the chain, about 1150 m. (3775 ft.) long, on a grade of 1.5 per cent., (79.2 ft. per mile), with the track well maintained, is equal to

$$W = (230.1 + 1150\times 0.052)\,(5+15) = 5800 \text{ kilos.}$$

so that three locomotives are all that is required.

ANTWERP'S NEW GROWTH.

Englishmen, who have always shown great interest in the welfare of their neighbor Belgium, may be pleased to hear that that little country now possesses, in Antwerp, the chief port on the Continent. Whereas the tonnage entering and leaving such important ports as Liverpool and Havre only quadrupled between the years 1833 and 1873, at Antwerp, in the same space of time, it became sixteen times more considerable. Since 1873 the progress has continued, and made very rapid advances. In 1883, the tonnage of the port reached 3,734,428 registered tons. This marvelous development is partly due to the position of Antwerp as the embarking point from the Continent of Europe to America, and partly also to the recent additions and changes which have been carried out there, and which, now nearly entirely completed, have made this cosmopolitan port one of the best organized in the world. This is so well known that vessels bound for Switzerland with a cargo of corn from Russia pass Marseilles and go 2,000 miles out of their way for the purpose of unloading at Antwerp. No other port, in fact, offers the same facilities. There is not another place in the world where fifty vessels of 3,000 tons can come alongside as easily as the penny boats on the Thames run into the landing places.

Since the opening of the St. Gothard Tunnel, nearly all the alimentary provisions that Italy sends to the British Isles pass through Antwerp. In 1882 82,000,000 eggs and 30,000 pounds of fruit were shipped there for England. The greater part of these came from Italy. Antwerp has become also an important port for emigrants; 35,125 embarked in 1882, out of which number 3,055 were bound for New York. The city was always destined, from its topographical position, to be at the head of a very considerable traffic; political reasons alone for many years prevented this being the case. These have happily now disappeared, and since 1863, when "the Scheldt was liberated," the progress of commerce has been more rapid than ever the most ardent Antwerp patriot dared hope. At that date the toll of 1s. 11d. on all vessels going up the river, and of 7½d on vessels going down, was abolished, and reforms were introduced among the ta_es on the general navigation; the tax on the tonnage in the port itself was abolished, and the pilot tax was lowered. The result of these measures became immediately apparent. Traffic increased with such rapidity that in 1876 the crowding on the quays was such that the relation of the tonnage to the length of the quay was about 270 tons per yard, which is about four times as great as at Liverpool.

A few words now, briefly, as to the nature of the important works nearly completed at Antwerp. They were commenced in 1877, and have opened for the port an era of prosperity such as was never experienced even during the

sixteenth century, the zenith of her splendor. These works have cost £4,000,000, and have necessitated the employment of 12,000 tons of wrought iron, of 490,000 cubic yards of brick work and concrete, of 32,000 cubic yards of masonry, and of more than 3,300,000 cubic yards of earth work in filling and dredging, etc. The quay wall runs the whole length of the town, a distance of rather more than two miles. It rests on a foundation laid without timber footings, and giving a depth of twenty-six feet at low water, sufficient drawing for the largest ships afloat. Beyond this wall are the real quays, which consist of—first, a line of rails reserved for hydraulic cranes serving to unload vessels and deposit their cargo in railway trucks; secondly, a second line of rails parallel with the first, on which these trucks are stationed; thirdly, sheds extending toward the town for a width of 150 feet, and covered with galvanized iron sheetings. A third line of rails parallel with the two others runs from end to end of these sheds, and a number of lines placed transversely with this one connect it by means of spring bridges with, fourthly, four more lines, also parallel with the quays, whence the goods start for the different stations, and thence to their destinations. The total width of these immense constructions is about 320 feet. Such is their magnitude that about 600 houses had to be pulled down to make place for them. A railing, running along their entire length, cuts them off from the town.

During the course of last year, 4,379 vessels entered the port of Antwerp, gauging a total of 3,734,428 tons, which places Antwerp, as I have already stated, at the head of European ports. In 1882, the tonnage of Havre was only 2,200,000, that of Genoa 2,250,000, and of Bilboa 315,000, owing to its iron ore exports. Among the English ports, a few only exceed Antwerp. London is still the first port in the world, with a tonnage of 10,421,000 tons, and Liverpool the second, with 7,351,000; Newcastle follows with 6,000,000 tons, also in excess of Antwerp, but both Hull and Glasgow are below, with respectively 1,875,000 and 2,110,000 tons—*Pall Mall Gazette.*

LUBRICATION.

A subject which does not generally receive the attention it deserves was brought before the members of the Manchester Association of Employes, Foremen, and Draughtsmen, in an interesting paper read by Mr. J. Veitch Wilson, on the lubrication of ordinary bearings and of bearings and faces subject to the action of steam. Mr. Wilson dealt with the question in an exhaustive manner. With regard to ordinary bearings under normal atmospheric conditions, he laid down that the lubricants to be employed should possess the following essential properties: They must not give off inflammable vapor under 350 deg. Fah.; they must not act upon the metals with which they come in contact, nor oxidise, which tended to spontaneous combustion and clogged the machinery: they must have body adapted to the work to be done; their boiling point must be sufficiently high to prevent evaporation and secure durability, and their freezing point must be low enough to ensure regularity of feed from the oil cups and convenience in handling. As the result of numerous experiments, he had become convinced that mineral oils were, if used alone, unsatisfactory lubricants; but bearing in mind the fact that mineral oils could now be obtained in every respect as safe as the finest animal oils, and that the admixture of mineral oil with animal or vegetable oils neutralized the acidity in the one case and the acidity and oxidizing tendency in the other, he was of opinion that the safest, most efficient, and most economical lubricants for all manner of bearings were to be found in a judicious mixture of animal or vegetable with good mineral oils.

With regard to cylinder lubricants, the peculiar conditions were the liberation of natural acids from vegetable and animal fats by the action of steam and heat, the action of these acids on the cylinders, and the evidence that in these acids were constituents parts of all animal and vegetable fats and oils; they could not be removed by any process of refining. One of the lubricants largely in use was tallow, but that this was the cause of considerable injury of the engine cylinders he had abundant evidence to prove. From the mass of evidence he had collected upon the subject, he was convinced that if care were exercised in the selection of the oil, and equal care in its preparation and application, hydrocarbon oil would be found thoroughly efficient as a cylinder lubricant, absolutely harmless and much more economical than tallow. Sometimes a small percentage of vegetable or animal matter was added, in order to increase the lubricating properties, and in his experience this had always been attended with favorable results. Hot-air engines might be lubricated on the same principle as steam cylinders, but gas-engines presented a new and special feature, as in their case the lubricant was not only subjected temporarily to the intense heat of the explosion, but also came in direct contact with the flame, and was liable to be carbonized thereby. If therefore, vegetable or animal oils and fats were objectionable in steam cylinders, they were much more so in the cylinders of gas engines.

Railways in China.

A Pekin telegram to the London *Times* says: The Imperial Government has come to a decision of great importance—that, namely, of sanctioning in principle the introduction of railways into the country. The Empress called upon the great functionaries of state to submit plans for the construction and management of strategical and commercial lines. Proposals were accordingly made by the Viceroy Li Hung Chang and other representatives of the progressive school, to be carried out on the conclusion of a definitive treaty with France.

Li Hung Chang is now convinced by experience that no public work requiring organization and financial accuracy can be undertaken by the Chinese themselves. Consequently the railways must be constructed and managed by skilled foreigners.

But the Government has a natural dread of the inroads of foreigners, and is unwilling to assign them rights over the soil of China. There will, therefore, be a strong disinclination to grant concessions, whether for making railways or for mining, except to natives. But since the Chinese people lack the requisite intelligence, the railway problem will probably be solved by the Government itself assuming the responsibility of making state lines. This can only be done by the creation of a new department, to be managed by foreigners in the Chinese service, this department to have complete control over the construction, working and financing of the railways,

Fortunately the Government, which does everything by precedent, possesses proofs of the efficiency of such service in the admirable organization of its own maritime customs. Like all reforms in China, the customs system was forced on the Government by the pressure of necessity. The principal seaport, Shanghai, having fallen into the hands of the Taiping rebels in 1853, the functions of government were suspended, and Sir Rutherford Alcock, then British Consul at Shanghai, in conjunction with the Consuls of France and the United States, collected the duties by means of inspectors appointed by themselves, Sir Thomas Wade, then English Vice Consul, being the first executive officer in the service lent for the immergency by the British Government.

This system has spread under new treatise until its ramifications now extend to twenty seaports. It may, without flattery, be described as probably the model of a customs service for the whole world; the most efficient, the most accomodating to merchants, absolutely incorruptible, yet extremely popular. It furnishes the Government with the only portion of its revenue which can be relied on to come in. The system has been matured by its chief, Sir Robert Hart, who has been Inspector General for twenty years, and has exercised absolute control, the high Chinese functionaries never intefering with him.

The service contains able men, Mr. Detring, for example, who suggested the Franco-Chinese negotiations, would be well qualified to establish a new state department of public works, having the same status as that of the maritime customs. Should the construction of railways be undertaken in China it will probably be upon some such basis.

The Railroad Ferry Boat "Solano," San Francisco, Cal.

Until recently, trains running to and from Oaklands upon the Central Pacific Railroad, were compelled to make a somewhat wide detour to skirt the eastern and southern sides of Pablo Bay, which is one of the indentations of San Francisco Bay. Oaklands is situated immediately opposite the city of San Francisco that stands on the north point of the narrow strip of land forming the western enclosure of the bay; the distance between Oaklands and San Francisco is about five miles. Some thirty five miles to the west, and a little to the north, Pablo Bay contracts until the distance between its north and south banks is only about two miles; this contraction forms the Straits of Carquinez, and on each side opposite each other, are the towns of Benicia and Port Costa. It is at this point that the Central Pacific Railroad Company have established the ferry which forms the subject of the illustrations in this week's issue. By means of it the circuitous route around Pablo Bay is avoided, and passengers are taken direct to Benicia and thence to Oaklands, the terminus of the railway. Fig. 1 is a longitudinal section of the ferry, showing the arrangement of the stage by which the trains are transferred to and from the boat; this part of the work is also shown in Fig. 2. Fig. 3 is a transverse section of the ferry, and Fig. 4 a plan showing the general arrangement of the boat as well as of the sidings and approaches. Fig. 5 is a perspective view of the boat, and Fig. 6 a sketch of the whole work.

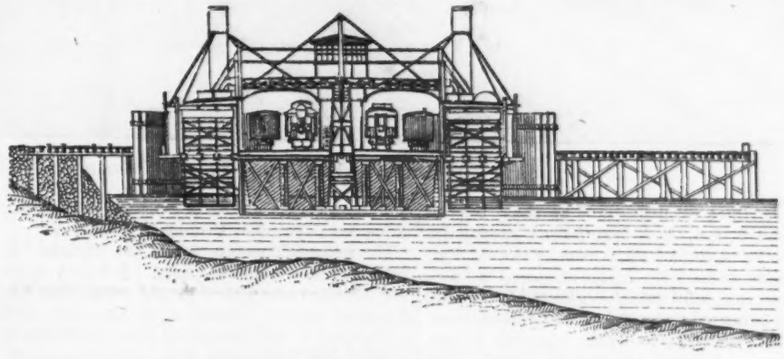


Fig. 4.—CROSS-SECTION, R. R. FERRY—"SOLANO."

The ferry, which is named the Solano, is a vessel of 3540 tons, and is of the following dimensions:

	FT.	IN.
Length of main deck	494	8
" hull	406	2
Width over all	116	0
" between wheel casings	64	0
Height amidships	18	6
" at ends	15	9
Draught when loaded	6	6

The boat is propelled by two separate vertical beam engines; they were built by Messrs. Harlan and Hollingsworth, of Wilmington, Delaware. The cylinders are 5 ft, 2.24 in. in diameter, and 11 ft. .28 in. stroke; each engine is intended to develop 2000 H. P. There are eight steam boilers, each 7 ft. .35 in. in diameter, and 28 ft. .24 in. long. They are made of steel, and have 143 tubes 3.94 in. in diameter, and 16 ft. long; the total heating surface is 19,930 square feet. The wheels are 30 ft. in diameter, and have 24 floats; each wheel can be worked independently of the other. It will be seen from the engravings that the ferry

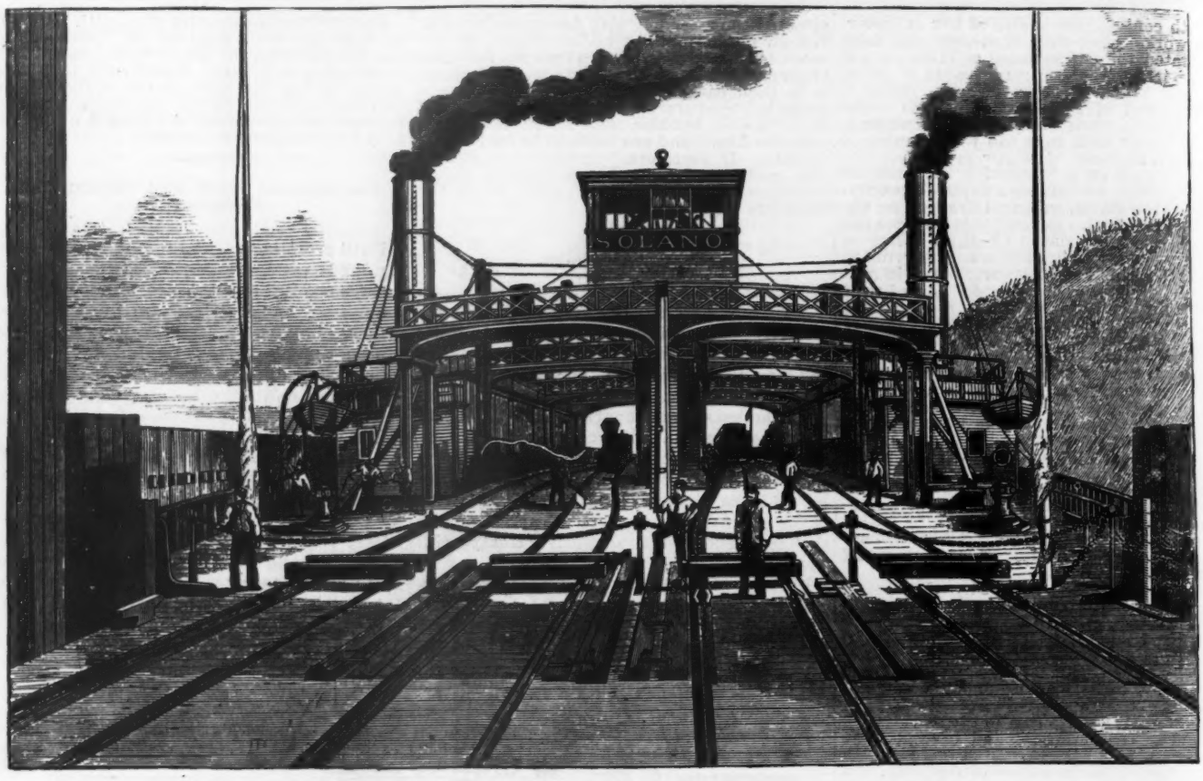


Fig. 5.—Railroad Ferry-Boat "Solano"—End View.

has four lines of rails, and as they extend from end to end, there is sufficient accomodation for forty-eight freight cars or twenty four passenger cars, with locomotive and tender. The boat is chiefly used for passenger service, freight being taken by the old route, and transferred at Oaklands to finish running to San Francisco. As the amount of freight thus carried is very considerable, the service is an important one, and the boats are large enough each to carry a number of wagons, which are unloaded in the San Francisco depot,

The general construction of the "Solano" is indicated in the illustrations. Beneath each line of rails runs a deep Pratt truss, the top flange of which is attached to the deck, and the bottom to the hull of the boat; the latter is divided by bulkheads into twelve compartments. There are four balanced rudders at each end of the vessel, 10 ft. 6 in. long, and 6 ft. 6 in. high; these are worked by hydraulic steering gear, but can be actuated by hand if desired. The pilot house is more than 40 ft. above the deck. The stages for embarking and disembarking trains are massive iron structures, 98 ft. 6 in. long, and weighing 150 tons. They are provided with four lines of rails, and are controlled by hydraulic gear to adapt their position to the rise and fall of the tide.

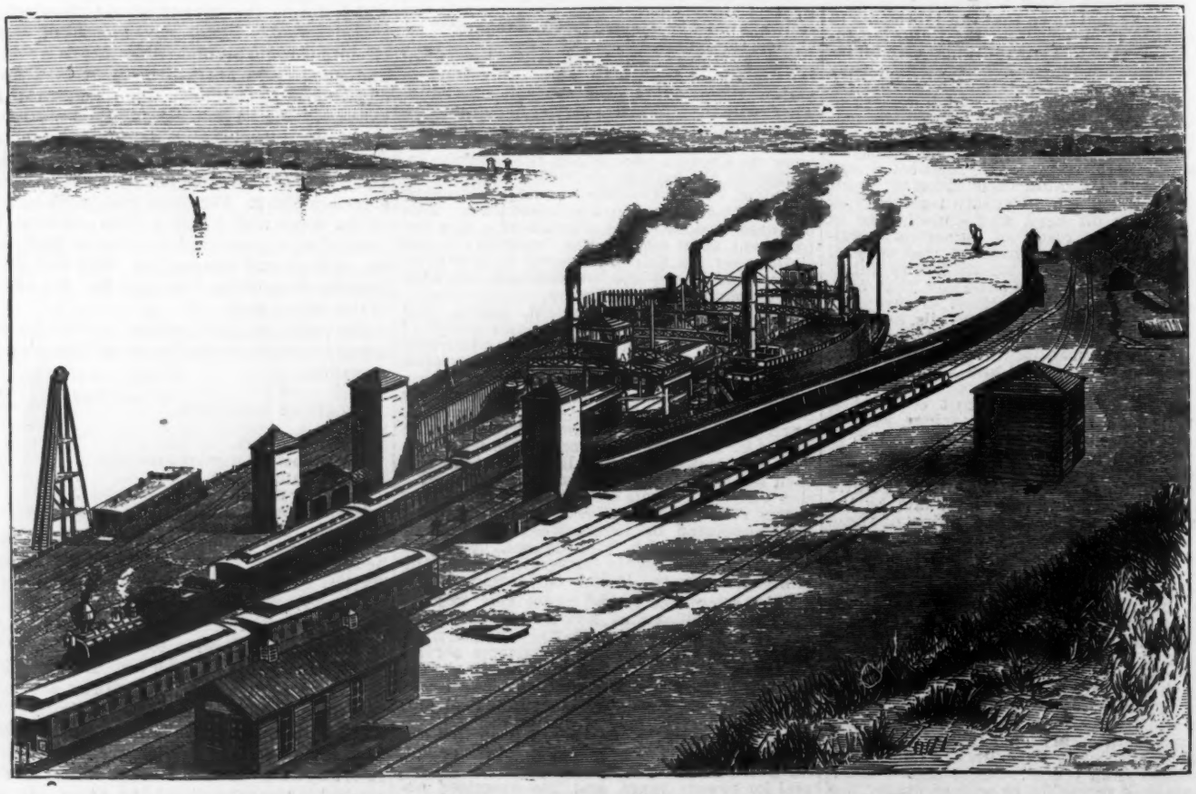
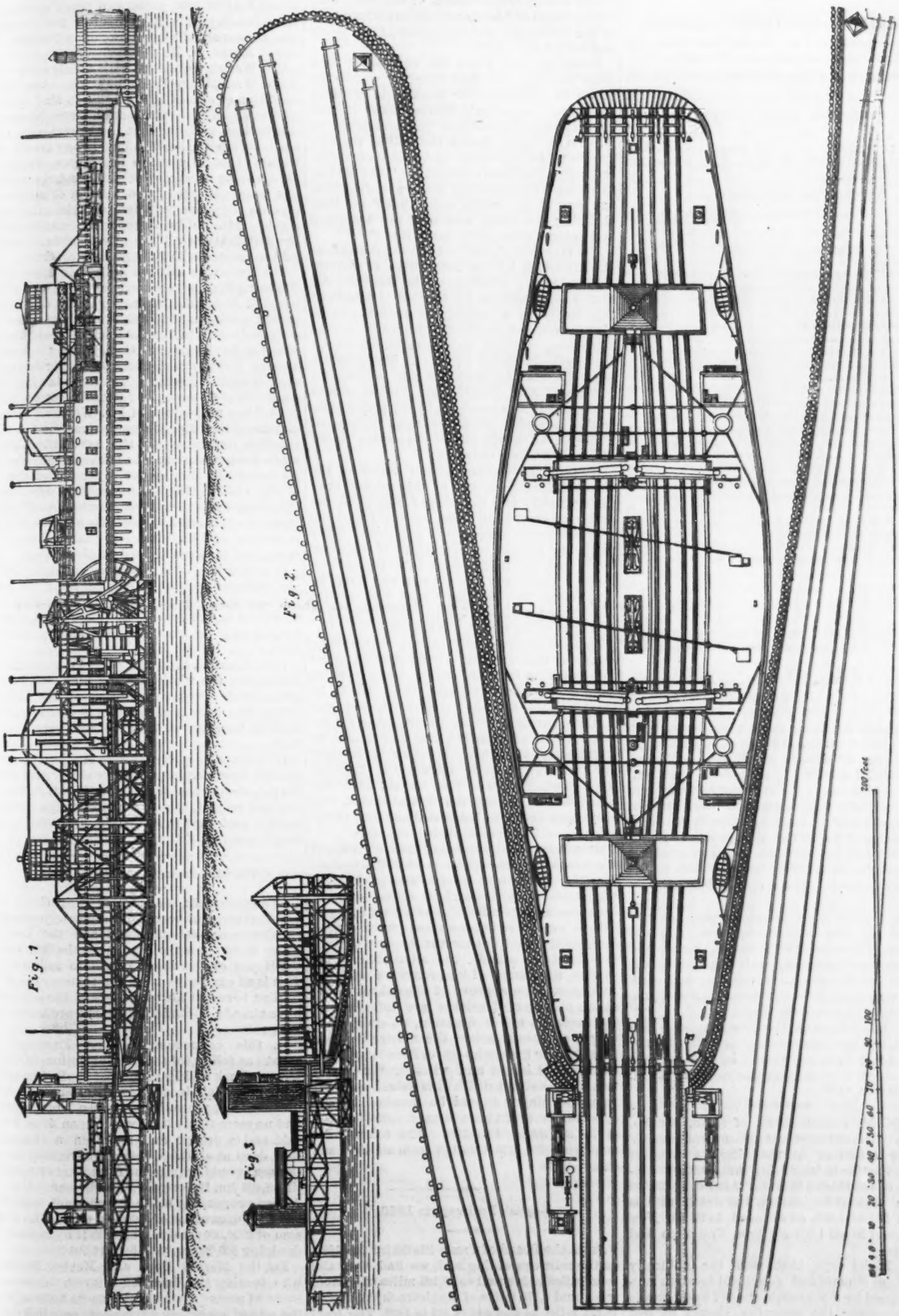


Fig. 6.—Railroad Ferry-Boat "Solano"—General View.



Figs. 1, 2, 3.—Railroad Ferry Boat "Solano." Longitudinal and Transverse Sections.

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EDWARD MEEKS, Publisher, of Philadelphia, announces as in preparation and soon to be issued "The Young Engineer's Own Book," by Stephen Roper the well known author upon Steam Engineering. This work is written expressly for the class to which it is dedicated, is clear and detailed in expression and well fitted for the use of the beginner and for educational institutions. Judging from the advance copy sent us, and from the acknowledged reputation of its author, we are assured that the book will be welcome to many students engaged in mechanical pursuits and to the young mechanic. The price will be $3.00.

THE Florida Ship Canal scheme has collapsed. It was incorporated with a grand flourish of trumpets, with Genls'. Butler and Mahone figuring among the incorporators, was to cost $80,000,000 or thereabouts, and work wonders generally in the transit of shipping from the Atlantic to the Gulf.

But the offices of the company are now closed, and the only outward sign of its former existence in Jacksonville is a bill for services as Engineer filed against the company by J. F. LeBaron, C. E.

C. H. M. BLAKE, C. E., of Silao, Mexico, writes to the editor of the *Mexican Financeer* calling attention to the absolute need of prompt action in improving the sanitary condition of the City of Mexico. Assuming 250,000 as the present population, the death rate is about 50 per 1,000, as apposed to 22 for New York, and 20 per 1,000 for San Francisco and Boston.

Mr. Blake says, that were the naturally healthful climate and delightful location supplemented by a modern system of water-works and sewerage, the mortality should be less than that of the American cities named, probably 18 per 1,000.

The Broadway Franchise.

The veto by Mayor Edson of the resolution of the Board of Aldermen granting a franchise to the Broadway Surface Railroad, is timely and well done.

Under the law of 1884 the citizens of New York have, for the first time for years, the power to determine for themselves whether the most important thoroughfare in the country shall or shall not be incumbered by a horse railroad. But as the will of the citizens is to be expressed through their representatives, the "local authorities," the Mayor, in his capacity of chief of the local authorities, can not be too much commended for thus checking the hasty action of the Aldermen and guarding the public interests.

The same law of 1884 provides for the sale at public auction by the authorities of any incorporated city or village of the franchise for a surface railroad; and in the case of Broadway this franchise is entirely to valuable to be given away, as it was by the resolution of the Aldermen, without any restrictions except such as the law itself provides. Mayor Edson estimates that this franchise can be sold for $1,000,000, and considering the enormous traffic and profits resulting to any corporation having exclusive privileges upon this great highway, we should say this figure was rather under than above the mark.

We can only wonder at the action of the Board of Aldermen, who in this matter have most willfully and shamefully neglected the duties imposed upon them, and betrayed the people they are supposed to represent. They have but themselves to blame if improper motives are ascribed to them in their late resolution. Their duty was plain, it was fixed by law, and in this particular case they should have been controlled only by what was most evidently to the interest of the city.

That the Aldermen have the law on their side, inasmuch that they had a legal right to grant this franchise is no argument. They have no right to give away privileges which might be made a source of great income to the city, and if these privileges were worth much to one corporation, it is possible, that they would be worth more to another. To clear themselves of the charge of undue influence or interest, if for no other purpose, they should have disposed of these rights to the highest bidder. The city would have been benefitted and they themselves would have done their plain duty.

Broadway is the main artery of New York, and it's present dimensions are so restricted that we should consider well before further clogging the circulation by laying in it a double line of rails for surface traffic. Tunnel under it, if you will, or widen and improve the parallel streets, for it needs relief, but we fear the cars will not give it. As it stands, the advocates of the road in the shape of its promoters and the Aldermen alone approve of the scheme; and as the opinions of neither are infallible or their motives above question, we do not see why they should settle the matter between them for the manywho travel Broadway. But we await the issue; and whether the resolution dies a natural death or is passed over the veto, the Mayor should be thanked for the opportunity given for a further consideration of its merits or demerits. The scheme demands careful investigation from all its many standpoints.

English Railways in 1883.

From the Board of Trade Statistics for 1883, on the railways of England, we find that the total mileage is equal to 10,105 miles of double track and 8,576 miles of singletrack, a total of 18,681 miles as against 18,457 in 1882. The total capital vested is nearly £785,000,000; the return upon this capital is 4.29 per cent.

The Memphis and Keene Sewers.

Col. Geo. E. Waring, in the *American Architect* of July 19, 1884, presents a paper upon the Memphis Separate System after four years' use, accompanied by remarks upon the sewerage of Keene, N. H.

Col. Waring embodies in his article a report from Wm. Henry Baldwin, C. E., upon the condition of affairs in Memphis in May, 1884; who upon careful examination states, that he can find no evidence that the sewerage work has been modified or changed in any essential feature; that no part has been reconstructed, except some necessary repairs, and the work has been extended by a number of miles of pipe on the same principle as originally designed. Mr. Baldwin's report is sustained by the certificate of all the city officials in any way connected with the sewerage system.

The numerous adverse criticisms upon the "Waring System" are next taken up and disposed of in detail. In answer to the often-repeated assertion that this system was simply a transplanting to American soil of established practice in England; Col. Waring quotes Messrs. Rawlinson & Field as supporting his system, and M. Lavoinne, Engineer-in-chief of the *Ponts et Chausées*, as distinctly referring to it as "the proposition of Mr. Waring." The statement that English engineers "do not altogether depend upon" the use of the automatic flush tanks could be made still stronger, for practically they do not depend upon them at all. Col. Waring is confident that when the Memphis system was constructed, only one English engineer had used flush tanks at all in sewers, and had used less than a dozen of them, and then not as used at Memphis.

It is denied that a man was engaged "for the exclusive purpose of looking after the 184 flush tanks," this individual referred to was employed in preventing the small feed pipes from silting up from the very muddy water used.

It is declared that not one of the original features in the whole Waring plan has been abandoned, excepting the fresh-air inlet, which was only used on the first few lines. Neither have any of their features been modified.

In reference to Keene, N. H., letters are quoted from the inspecting engineer and the Mayor, stating that the system is satisfactory in every respect, that it operates "like clockwork," and that it meets the approval of a large majority of the citizens.

The Manchester Ship Canal, Eng.

As a project the Manchester Ship Canal is unfortunate; last year, after much opposition, the Commons passed the Bill and the Lords threw it out; now the Lords pass the Bill and the House of Commons refuse to acquiesce. This is an expensive game for someone, as according to report the promoters of the scheme have already spent $600,000 in the preliminary "log-rolling."

In this connection London *Engineering* speaks as follows of the present action of the Mersey Dock and Harbor Board:—In 1882 the tonnage paying dues at Liverpool was 8,100,000 tons. Of late years the bar in the Mersey has had no more than 9 ft. of water upon it at low tide, and to dredge and maintain a channel 30 ft. deep at all tides, between Liverpool and the sea, would require the formation of a cutting 8,400 lin. ft. long through the bar. A Mr. Aitken proposes to make this channel, 2,400 ft. wide, an excavation of 9,000,000 cu. yds. for the sum of £320,000; and to maintain it by annually dredging 500,000 cu. yds. for £12,500.

But the Mersey Dock and Harbor Board, who receive the dues and lavish immense sums of money upon the docks, do nothing in the way of improving navigation, save lighting and buoying the channel and removing the wrecks.

Engineering thinks it is time to consider the question of either making this Liverpool Board act for the public in the matter of improving the channel, or of calling upon them to make way for a new authority established upon a broader basis, and likely to possess more extended ideas of their duties.

The delay and inconvenience to ocean travel is referred to, compelling the American steamers to haul off into mid channel. And the importance of this post in a time of war would also be great; with the present shallow water at the mouth of the Mersey a fleet could not issue except at high tide, and a disabled man-of-war might sink or be captured before it could get in. A good harbor entrance at this point is also wanted by the merchant marine, for excepting the not very good harbor of Holyhead there is not a port of refuge on the west coast of England between the Clyde and Milford Haven.

Engineering finally remarks that in "America France and most other countries, such works as these would be under Government control. Englishmen prefer to leave such matters to private enterprise, but we think that the interest which has been aroused by the proposal to make a Ship Canal to Manchester, affords a fitting opportunity for directing public attention to the still larger subject which has lain dormant, and is well worthy of the deepest attention, not merely of individuals, but of the Government of the country."

The Reservoir System at the Head of the Mississippi River.

Harper's Monthly for September contains an interesting illustrated article, by J. S. Pyle, upon the reservoir system as applied to the improvement of navigation upon the upper Mississippi.

The first steps in this project were taken with reference to the preservation of the Falls of St. Anthony, and surveys were made by a Mr. Cook, of Minneapolis, under the direction of Gen. G. K. Warren, U. S. A. But Gen. Warren, impressed with the wider range of the subject, concluded that other and greater benefits to the river below could be derived from this system, and in 1870 embodied recommendations to that effect in his annual report. In 1873-4 Col. F. U. Farquhar, U. S. Engr's., made extensive surveys of the lakes at the head of the Mississippi and decided in favor of reservoirs. In 1878 Maj. Chas. J. Allen was directed by the government to examine the matter in detail and make an exhaustive report upon the feasibility of the proposed reservoirs.

Upon the reception of Maj. Allen's report the government decided to make the attempt and Congress made appropriations sufficient to commence the construction of an experimental reservoir. The work has gone on steadily since that time under the able direction of Major Allen.

This reservoir system contemplates the erection of five dams on the Mississippi proper, in its upper courses, one on each of two of its earliest tributaries and others on the head-waters of the St. Croix, Chippewa and Wisconsin. To understand the topographical situation, it is well to mention that the "lake-region" of Minnesota is literally covered with a succession of lakes, which are simply expansions of the streams, with a very gradual slope and placid flow, and the land lying between them rarely elevated more than 30 ft. above the water surface. The elevation above sea-level of a point between Cass Lake and Itasca, the limit to which the flowage of the uppermost reservoir will reach, is 1,304 ft.; at the foot of Pokegama Falls, the lowest point in the reservoir system, and 350 miles above St. Paul, the elevation is 1,255 ft.

The situations of the five dams to be built, beginning with the most northern, are at the outlet of Lake Winibigoshish, 110 miles north and west of Duluth and 200 miles north of St. Paul; at the outlet of Leech Lake; at the outlet of Mud Lake; below the mouth of Vermilion River, and at Pokegama Falls.

It is claimed that by the construction of these works on the upper Mississippi, navigation will be benefited as far as the head of Lake Pepin; 55 miles below St. Paul, and that incidentally, river floods will be placed under more or less perfect control.

The reservoirs are only to be opened in the interest of navigation about July 1. From April 1 to July 1, it is estimated that 41,751,903,840 cu. ft. of water pass the Falls of Pokegama. The reservoir should not be open for navigation only after Nov. 1, and the flow from Nov 1 to April 1, would add 7,344,000 cu. ft. to the above.

Supposing that under the most adverse circumstances these seven reservoirs were capable of augmenting the volume of the stream by 5,400 cu. ft. per second, as the lowest stage of water at St. Paul is 5,800 cu. ft., this addition would more than double the volume. Major Allen figures that with a width of water surface of 1,500 ft. the safe ruling depth for a flow of 12,200 cu. ft. per second would be at least 4 ft. The total estimated cost of the seven dams is $558,135.

The type of dam adopted may be described as follows: Dams 10 ft. wide at top with side slopes of 1 to 2, in the center is a sheet piling of 6-in. timber driven to the blue clay and rising 2 ft. above the high water line, enclosing this piling is a puddle wall 6 ft. thick at top and with side batter of 1 to 6, this puddle wall is founded in the clay and extends 6 ft. above high water mark. Outside of the puddle wall the dam is chiefly sand and earth, the toe is protected by sheet piling on both sides and the slopes are covered with 2 ft. of clay and then rip-rapped with stone. Twenty-four sluice gates are constructed through a mass of crib-timber work, resting upon pile foundation, and proportioned to pass 12,000 cu. ft. per second.

Actual work was commenced at Winibigoshish on Jan. 9, 1882. A saw mill was first erected capable of cutting 25,000 ft. B. M. per day; the 1,750,000 ft. B. M. required for this dam was cut on the borders of the Lake, it is magnificent Norway and White pine. The dam at Leech Lake has also been commenced.

Replacing an Iron Bridge.

The *Moniteur Industriel* describes a rather novel method of replacing an old style iron bridge by one of later construction on the line of the Railroad of the North of Bohemia, between Kuttenthal and Stranow—Krnsko.

The ravine crossed was 98 ft. deep, and the span of the bridge was 131⅞ ft., weight of truss 80 tons.

The method adopted was to erect each bridge span upon rollers, and, then, by means of a locomotive, pull it above the place it was to occupy on top of the old bridge. The span was then raised by hydraulic jacks and the rollers removed. This done, the members of the original bridge were suspended to the new truss, in such manner that the workmen were enabled to remove them, the men working upon a platform swung beneath. As soon as the old bridge was removed the new truss was lowered, a distance of 15 ft., to it's final bearing upon the piers,

Trains were stopped during the operation of substituting the new truss; the total time consumed was less than 48 hours.

SYDNEY, New South Wales, has a Bill pending in the Parliament, to authorize the Town Council of Sydney to expend $1,000,000 in wood pavement.

ENGINEERING NEWS—Three months for One Dollar.

The Hydraulic Distribution of Power in London.

It may not be generally known on this side of the Atlantic that a London Corporation has been furnishing water as a motive power since 1882. Experiments were first made in Hull in 1875 and the feasibility of the project being there proven the scheme was applied to London to be utilized in hoists, presses or hydraulic engines and distributed by mains through the streets.

The company is called the General Hydraulic Power Company, and a Bill, lately passed, has just enlarged the area of its operations. The company is empowered to take one million gallons of water per day from the Thames, this quantity if used in ten hours would correspond to 800 horse-power equally distributed but as supplied to an intermittent demand it would represent 2000 to 3000 horse-power.

The water is lifted by two centrifugal pumps to tanks on top of the building, and, as the water is generally very mudy, it is cleaned by settling and then running through compressed sponge filters. The power-pumps are driven by inverted compound 3-cylinder engines, having one high pressure cylinder 19 in. in diameter and two 25-in. low pressure cylinders with 2 ft. stroke. The pumps deliver into two accumulators, 20-in. diameter and 23 ft. lift, loaded to give a pressure of 700 lbs. to the sq. in. in the mains. There are two sets of these pumping engines, each about 130 H. P., already in position and another set is under construction.

The mains, which now aggregate 7 or 8 miles in length, are cast-iron pipes 6 in. in diameter. They are cast in 9 ft. lengths and tested to 2500 lbs. per sq. in. The joints are turned and bored spigots and sockets, made tight with gutta-percha rings, and tied by two 1¼-in. bolts passing through lugs on the pipes. Stop-valves are inserted every 400 or 500 yards.

The company is financially a success; the charges for power are based upon a minimum payment of 25s. per quarter for each machine, and a sliding scale for the water which is measured by a metre. The following is the scale of prices used:

	Per Machine. £.	s.	d.
Under 3,000 gals., per quarter	1	5	0
	Per 1000 gals.		
Above 3,000 " not exceeding 5,000 gals.	0	8	0
" 5,000 " " " 10,000 "	0	7	0
" 10,000 " " " 20,000 "	0	6	0
" 20,000 " " " 50,000 "	0	5	0
" 50,000 " " " 100,000 "	0	4	0
" 100,000 " " " 200,000 "	0	3	0
" 200,000 by special terms.			

In many cases the cost of lifting by the company's power is as low as one halfpenny per ton lifted 50 ft. high.

PERSONAL.

LIEUTENANT COLONEL WALTER MCFARLAND, LIEUTENANT COLONEL J. M. WILSON and MAJOR L. C. OVERMAN, Corps of Engineers, have been directed to assemble at Cleveland, Ohio, September 10, to consider questions in relation to the Cleveland breakwater.

MR. S. H. KNEELAND had voted to him a salary of $25,000 per annum, as President of the Metropolitan Elevated Railway Co. This was a legacy left to the new Manhattan Co. by the out-going Directors of the Metropolitan, and as $47,000, or nearly two years' salary are due, it is understood that MR. GOULD will dispute the bill.

COL. C. E. BLUNT, LIEUT.-COL. W. P. CRAIGHILL, and LIEUT.-COL. WALTER MCFARLAND, with MAJOR C. W. RAYMOND, have been appointed in accordance with a provision in the River and Harbor bill appropriating $100,000 for the construction of a national harbor of refuge of the first-class at Sandy Bay. The board will meet in Boston, August 20. It is to

determine the question if the point selected is or is not the best location on the coast between Portland and Boston for such a harbor as is required.

CHARLES MANBY, an English engineer, is dead. He was the son of AARON MANBY, of the Horsley Iron Works, Staffordshire, and was born there in 1804. He was at an early age engaged in constructing the first marine engines with oscillating cylinders, patented by his father, and in 1820 designed and constructed the Aaron Manby, the first iron steamer that ever made a sea voyage, he serving as chief engineer on board. He subsequently took a contract for the erection of a vast gas works at Paris; was one of the managers of the iron works at Charenton, near Paris; remodeled the Creusot Iron Works and became chief engineer of the tobacco factories for the French Government. He was in Australia in 1829-36, in connection with the Beaufort Iron Works. He became afterward the London representative of Robert Stephenson & Co., and was Secretary of the Institute of Civil Engineers, 1839-56. He was lieutenant colonel of the Engineers and Railway Volunteer Staff Corps, and extensively engaged on scientific commissions and investigations, especially that relating to the Suez Canal.

TURNOUTS:

Exact Formulæ for their Determination, together with Practical and Accurate Tables for Direct use in the Field.*

BY W. B. PARSONS, JR., C. E., ROADMASTER NEW YORK AND GREENWOOD LAKE DIVISION, ERIE RAILWAY.

(*Continued from page 80.*)

Table No. 2—gives value of turnout radii when passing from either the inside or the outside of the curve. The left-hand vertical column gives degree of curvature of main track and the next shows whether turnout is from inside or outside of the same. The horizontal rows contain the length of the radii for these conditions, corresponding to the frog numbers at the top of the table.

Table No. 7.—Bills of Switch-Timbers for Frog No. 7.

18-*in. Centres.*			22½-*in. Centres.*		
PIECE.		LENGTH.	PIECE.		LENGTH.
1	6″ × 8″ ×	8′ 6″	1	6″ × 8″ ×	8′ 6″
1	"	8′ 7″	1	"	8′ 7″
1	"	8′ 8″	1	"	8′ 8″
1	"	8′ 9″	1	"	8′ 10″
1	"	8′ 10″	1	"	8′ 11″
1	"	8′ 11″	1	"	9′ 0″
1	"	9′ 0″	1	"	9′ 2″
1	"	9′ 1″	1	"	9′ 4″
1	"	9′ 2″	1	"	9′ 5″
1	"	9′ 4″	1	"	9′ 7″
1	"	9′ 5″	1	"	9′ 8″
1	"	9′ 7″	1	"	9′ 10″
1	"	9′ 8″	1	"	10′ 0″
1	"	9′ 10″	1	"	10′ 1″
1	"	10′ 0″	1	"	10′ 4″
1	"	10′ 1″	1	"	10′ 6″
1	"	10′ 4″	1	"	10′ 8″
1	"	10′ 6″	1	"	10′ 11″
1	"	10′ 8″	1	"	11′ 1″
1	"	10′ 10″	1	"	11′ 4″
1	"	11′ 0″	1	"	11′ 7″
1	"	11′ 1″	1	"	11′ 10″
1	"	11′ 4″	1	"	12′ 1″
1	"	11′ 7″	1	"	12′ 4″
1	"	11′ 8″	1	"	12′ 7″
1	"	11′ 10″	1	"	12′ 10″
1	"	12′ 1″	1	"	13′ 1″
1	"	12′ 4″	1	"	13′ 5″
1	"	12′ 7″	1	"	13′ 8″
1	"	12′ 8″	1	"	13′ 11″
1	"	12′ 10″	1	"	14′ 2″
1	"	13′ 1″	1	"	14′ 6″
1	"	13′ 4″	1	"	14′ 9″
1	"	13′ 7″	1	"	15′ 0″
1	"	13′ 8″	1	"	15′ 3″
1	"	13′ 10″	1	"	15′ 6″
1	"	14′ 1″	1	"	15′ 8″
1	"	14′ 4″	1	"	15′ 10″
1	"	14′ 6″	1	"	16′ 1″
1	"	14′ 9″			
1	"	14′ 11″			
1	"	15′ 2″			
1	"	15′ 4″			
1	"	15′ 7″			
1	"	15′ 10″			
45 pieces.		520′ 3″ lin. 2081 ft. B. M.	36 pieces.		416′ 11″ lin. 1667.7 ft. B. M.

Table No. 8.—Bills of Switch Timbers of Frog No. 8.

18-*in. Centres.*			22½-*in. Centres.*		
PIECE.		LENGTH.	PIECE.		LENGTH.
1	6″ × 8″ ×	8′ 6″	1	6″ × 8″ ×	8′ 6″
2	"	8′ 7″	1	"	8′ 7″
1	"	8′ 8″	1	"	8′ 8″
1	"	8′ 9″	1	"	8′ 9″
1	"	8′ 10″	1	"	8′ 11″
1	"	8′ 11″	1	"	9′ 0″
1	"	9′ 0″	1	"	9′ 1″
1	"	9′ 1″	1	"	9′ 2″
1	"	9′ 2″	1	"	9′ 4″
1	"	9′ 3″	1	"	9′ 5″
1	"	9′ 4″	1	"	9′ 7″
1	"	9′ 6″	1	"	9′ 8″
1	"	9′ 7″	1	"	9′ 10″
1	"	9′ 8″	1	"	10′ 0″
1	"	9′ 9″	1	"	10′ 2″
1	"	9′ 11″	1	"	10′ 4″
1	"	10′ 0″	1	"	10′ 6″
1	"	10′ 2″	1	"	10′ 8″
1	"	10′ 4″	1	"	10′ 10″
1	"	10′ 5″	1	"	11′ 0″
1	"	10′ 7″	1	"	11′ 2″
1	"	10′ 9″	1	"	11′ 5″
1	"	10′ 10″	1	"	11′ 7″
1	"	11′ 0″	1	"	11′ 10″
1	"	11′ 2″	1	"	12′ 0″
1	"	11′ 4″	1	"	12′ 3″
1	"	11′ 6″	1	"	12′ 6″
1	"	11′ 8″	1	"	12′ 8″
1	"	11′ 10″	1	"	12′ 11″
1	"	12′ 0″	1	"	13′ 2″
1	"	12′ 2″	1	"	13′ 5″
1	"	12′ 4″	1	"	13′ 8″
1	"	12′ 6″	1	"	13′ 11″
1	"	12′ 8″	1	"	14′ 1″
1	"	12′ 11″	1	"	14′ 4″
1	"	13′ 1″	1	"	14′ 7″
1	"	13′ 3″	1	"	14′ 10″
1	"	13′ 5″	1	"	15′ 1″
1	"	13′ 8″	1	"	15′ 3″
1	"	13′ 10″	1	"	15′ 6″
1	"	14′ 0″	1	"	15′ 9″
1	"	14′ 2″	1	"	16′ 0″
1	"	14′ 5″			
1	"	14′ 7″			
1	"	14′ 9″			
1	"	14′ 11″			
1	"	15′ 2″			
1	"	15′ 4″			
1	"	15′ 6″			
1	"	15′ 9″			
1	"	15′ 11″			
52 pieces.		603′ 0″ lin. 2412 ft. B. M.	42 pieces.		489′ 11″ lin. 1959.7 ft. B. M.

The minus sign indicates, as explained on page 44, that the turnout curves in a reverse direction from the main-track. These minus values are printed in a heavy faced type to allow change be more readily detected.

Table No. 3—gives proper distance to locate the frog-points apart on a cross over. The horizontal row at the top gives various distances between the nearest *gauge* lines of parallel tracks. The left hand vertical column contains a series of frog numbers. The distances are to be measured on the parallel tracks.

Although computed for cross overs from straight tracks, it will be found practically correct for cross overs from curves. For convenience in using, this table is given in feet and inches.

Table No. 4—gives, at intervals of every 10 ft. from head-block measured on main-track, the ordinates of the turnout curve; that is, the distance between the main-track and outside lead-rails. By the use of this table the turnout curve can be accurately and rapidly laid out. Mark on the main-track rail, on which the frog is, every 10 ft. from the head-block, then opposite these spike down the lead-rail with the proper space between it and the main-rail as taken from the table, according to the frog number at left-hand side and distance from head-block at top. Between these points line by eye and then set the other lead-rail by gauge. The turnout curve will then be in true position and alignment.

In case it is a point switch where there is no head-block, first lay off the length of the moving rail corresponding to the frog as given in Table No. 1, and then after that the regular 10 ft. intervals. If the switch "point" is curved to the turnout radius these ordinates will fit exactly; if the "point" is straight, ordinate No. 1 may have to be forced slightly in order to conform.

A neat way to use the ordinates is to calculate them as between the rail flanges instead of gauge lines, since that gives a sharper edge to measure from. Of course distances so obtained are dependent upon the rail section.

Table No. 9.—Bills of Switch-Timber for Frog No. 9.

18-*in. Centres.*			22½-*in. Centres.*		
PIECE.		LENGTH.	PIECE.		LENGTH.
2	6″ × 8″ ×	8′ 6″	1	6″ × 8″ ×	8′ 6″
1	"	8′ 7″	2	"	8′ 7″
2	"	8′ 8″	1	"	8′ 8″
1	"	8′ 9″	1	"	8′ 9″
1	"	8′ 10″	1	"	8′ 11″
1	"	8′ 11″	1	"	9′ 0″
1	"	9′ 0″	1	"	9′ 1″
1	"	9′ 1″	1	"	9′ 2″
1	"	9′ 2″	1	"	9′ 3″
1	"	9′ 3″	1	"	9′ 5″
1	"	9′ 4″	1	"	9′ 6″
1	"	9′ 5″	1	"	9′ 7″
1	"	9′ 6″	1	"	9′ 9″
1	"	9′ 7″	1	"	9′ 10″
1	"	9′ 8″	1	"	10′ 0″
1	"	9′ 10″	1	"	10′ 2″
1	"	9′ 11″	1	"	10′ 4″
1	"	10′ 0″	1	"	10′ 5″
1	"	10′ 1″	1	"	10′ 7″
1	"	10′ 3″	1	"	10′ 9″
1	"	10′ 4″	1	"	10′ 11″
1	"	10′ 6″	1	"	11′ 1″
1	"	10′ 7″	1	"	11′ 3″
1	"	10′ 9″	1	"	11′ 5″
1	"	10′ 10″	1	"	11′ 7″
1	"	11′ 0″	1	"	11′ 10″
1	"	11′ 1″	1	"	12′ 0″
1	"	11′ 3″	1	"	12′ 2″
1	"	11′ 5″	1	"	12′ 5″
1	"	11′ 6″	1	"	12′ 7″
1	"	11′ 8″	1	"	12′ 10″
1	"	11′ 10″	1	"	13′ 0″
1	"	12′ 0″	1	"	13′ 3″
1	"	12′ 2″	1	"	13′ 5″
1	"	12′ 4″	1	"	13′ 8″
1	"	12′ 6″	1	"	13′ 10″
1	"	12′ 8″	1	"	14′ 1″
1	"	12′ 10″	1	"	14′ 3″
1	"	13′ 0″	1	"	14′ 6″
1	"	13′ 2″	1	"	14′ 8″
1	"	13′ 4″	1	"	14′ 11″
1	"	13′ 6″	1	"	15′ 1″
1	"	13′ 8″	1	"	15′ 4″
1	"	13′ 10″	1	"	15′ 6″
1	"	14′ 0″	1	"	15′ 9″
1	"	14′ 2″	1	"	15′ 11″
1	"	14′ 4″			
1	"	14′ 6″			
1	"	14′ 8″			
1	"	14′ 10″			
1	"	15′ 0″			
1	"	15′ 2″			
1	"	15′ 4″			
1	"	15′ 6″			
1	"	15′ 8″			
1	"	15′ 10″			
1	"	16′ 0″			
59 pieces.		686′ 3″ lin. 2745 ft. B. M.	47 pieces.		546′ 1″ lin. 2184.3 ft. B. M.

TO BE CONTINUED,

ANTHONY LAMB, Mathematical Instument Maker, At the Sign of the Quadrant and Surveying Compass, near the Old Slip Market in New York.

MAKES and sells all sorts of Mathematical Instruments in Wood, Ivory or Brass, etc., as Quadrants, Davis's Quadrant improv'd to observe without any regard to the Horizon, Fore Staffs, Nocturnals, Rectifiers, universal Scales, Gunters, Sliding Gunters, Guaging Rods, Rulers, Treble Rulers for ruling of blank Books, all sorts of wood or brass box Compasses for Sea Use, Pocket Compasses, all sorts of Surveying Compasses, small Ones to fix on a Walking Stick, and lengthened to a suitable Height, Surveying Chains of any length, Water-levels, Senecal Quadrants, all sorts of Scales, Protracters, parallel Rulers Trunk Telescopes, Walking Stick Spying Glasses, Universal or Equinoctial ring or horizontal Brass Dials, Steel or Brass jointed Compasses, drawing Pens, Three-legged Staves, Ship-wrights' Draught Bows, Bevels, Squares, Walking Sticks, and other small Work: Sundries of small Work turn'd in Hard Wood, Ivory or Brass, etc., as Sockets and Balls, Billiard or Truck Balls, Heads of Canes, Rims, and Tops for Spying Glasses etc. Any Person at a short Notice may have any of the Things above mentioned, by Wholesale or Retail, at reasonble Rates. Any small Work in Wood, Ivory or Brass, neatly repaired or mended. And Ready Money for old Kettles or other Brass.—*N. Y. Weekly Post Boy*, June 24th, 1745.

FOR sometime work has been going on preparatory to lessening the curvature of the Denver & Rio Grande track on the west side of Marshall Pass. Several thousand feet of new grading, cutting and filling has been done, on which the track is already laid, and it will be but a short time until trains are running over it. The track has been materially straightened and at the same time shortened. In a number of places heavy cuts have been made in the side of the mountains.

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CORRESPONDENCE.

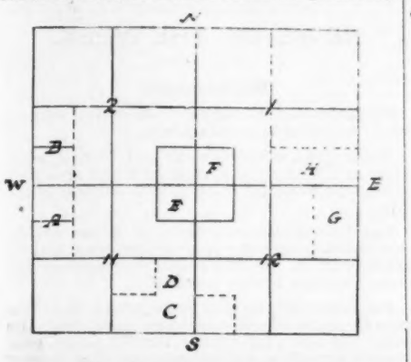
Sub-dividing Government Land.

Special Correspondence Engineering News.

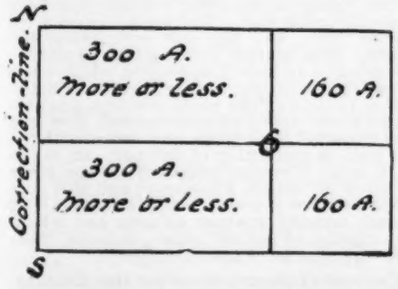
FITCHBURY, MASS., August 8, 1884.

EDITOR ENGINEERING NEWS:—Mr. EDDS, in his article in the issue of July 26th on the proper method of surveying and subdividing greater sections of Government land, touches a subject that has been the cause of no little difficulty in the subdivisions of land heretofore in the Western States, but in the course of his argument he either does not say what he means, or lays rather too much stress on what is practically of secondary importance. He says, "how would a fourth of a section surveyed in any other than the square shape, as above indicated, be sold and patented as a quarter section?" True enough, so far, but the laws relating to public lands nowhere say that land shall be sold and patented in greater sections.

The various laws relating to pre emption and homestead entries of land, if they mention the greater sec-



tion at all, nowhere require that the "legal subdivisions" of land—that is the term commonly used—shall be in the actual shape of a greater quarter, but do, in fact, allow, as the entries made at any land office under those laws show, the taking of 160 acres of land in any shape so that the several 40-acre tracts abut on each other to a distance equal to one of the sides of each or 80 rods. The pre-emptor or home-steader could, except in cases where alternate sections had been granted to railroad companies, take from 40-acre tracts, in a line, 80 × 3.20 rods in extent, or in the form of an L, three-forties in a string, and the fourth abutting against



either of the end forties, or as a T, abutting against the middle one—or he might take, say two-forties lying together north and south of each other, an extra forty on the east side of the north one and another on the west side of the south one, or change the points of compass and preserve the relative position of the forties, or again, if lying on navagable waters, could take any number of fractional lots whose aggregate area as calculated by the surveyor did not exceed 160 acres, lying contiguous and abutting on each other. Lastly, he could take his 160 acres of land in four different sections if so minded. If the quarter section or any of the forties over ran or fell short of 160 acres, it made no difference.

I know cases in Central North Missouri (the position north of the Missouri River), where the sections lying next east of a "correction" meridian line, containing sometimes from 900 to 1000 acres of land, a preemptor on either of the west quarter sections got 300 acres of land and over, say 160 rods north and south and 300 east and west, and the lands patented as preemptions, and if necessary sustained by the highest courts. What he says, however, as to confusion arising from the conflicting practices of County surveyors, in different States, in subdividing carelessly surveyed sections of land, is eminently true, and the evil arising therefrom should be corrected by laws enacted by Congress—as adjoining States, Missouri and Nebraska for example, had some years ago laws widely differing in the method prescribed by which the County surveyors are required to subdivide the land, and a surveyor removing from one State to another, and practising his profession there as he had already learned it in his former place of residence, has more than once led to vexatious disputes, eventuating in expensive lawsuits. I did a considerable amount of work in Nebraska as deputy county surveyor in 1856-7, and found the law of that territory guiding surveyors, much more reasonable than the Missouri law, on the same subject. There should be a general law, uniform in all parts of the country where government lands are found, on that point.

E. W. DINSMORE.

Constructing a Polygon of any Number of Sides.

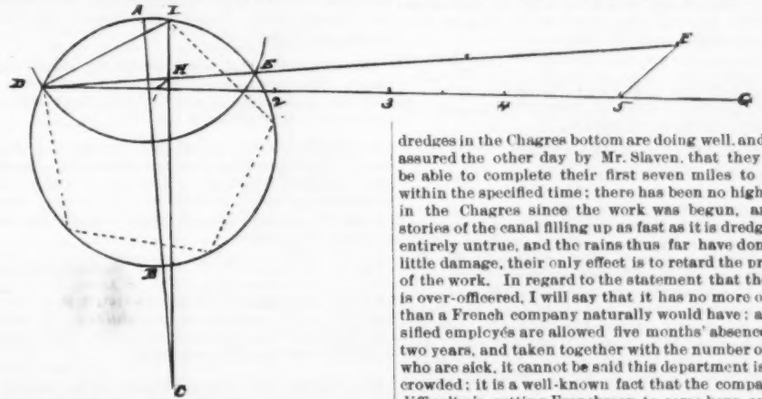
Special Correspondence Engineering News.

UNION PACIFIC RAILWAY CO., }
ENG'RS OFFICE, BELLEVILLE, KAN., Aug. 7, 1884. }

EDITOR ENGINEERING NEWS.—Enclosed I send you a simple and accurate method of constructing a polygon of any number of sides, that may be new to some of your readers.

Draw a circle. Draw the diameter *A B* and extend it outside to a distance equal to radius.

With *A* as a centre, and a radius equal to *B C* describe



an arc cutting the circle in *D* and *E*. Draw the chord D E and extend it outside the circle to a distance equal to 2 *D E* = *D F*.

Draw a line, *D G*, in any convenient direction, and lay off on it as many equal parts as there are sides to the proposed polygon.

Through the last point and the end of the chord produced, (5 and *F* in the figure) draw a line, and through the first point in the line *D G* draw a line parallel to 5 *F* intersecting the chord *D E* in *H*.

Through *C H* draw a line intersecting the circle in *I*. Draw the chord *D I* which is one of the equal sides of the polygon.

E. A. D. PARKER.

The Panama Canal.

Special Correspondence Engineering News.

PANAMA, Aug., 5, 1884.

EDITOR ENGINEERING NEWS.—I wish to correct some errors in regard to the Panama Canal which seem to be very widely spread in the United States. There are very many irresponsible parties passing through here or who have been employed by the company for a short time, who, on returning to the States think it a delightful pastime to say all sorts of ridiculous things in regard to this work. In your issue of July 12th was an article taken from the *Philadelphia Press* giving the story of Thomas Vincent Norton, who claims to have been engaged in engineering here for a year and went away on account of a sickness which he never had. His communication is a lot of mere bosh; there is no such frightful mortality among the men as he claims. During all of last year, when I had charge of location from Gatun to Bohio, and had often as many as fifty men on my different parties, most of them colored, there was not a man died in my employ, although the entire work was along the ill-famed Chagres River. We often had chills and fever, and I suffered severely for five months, but a stay of five weeks in New York during April and May enabled me to return here in the best of health. During this year, as contractor, I have been turning up the new earth, but it has not created an unusual amount of sickness. The company's doctor told me that at Bohio where there are six hundred men at work, there have been no deaths reported in six weeks, and that on the banks of the Chagres River. Certainly many have chills and fever and suffer a great deal, but there has not been a case of malignant fever in Bohio in a year. All the white people suffer more or less, none escape entirely, yet the fevers we have are not dangerous.

The greater portion of the laborers are from the Island of Jamaica, and as they subsist themselves many of them live very badly, and for that reason there is much more sickness than than otherwise would be, yet they rarely suffer from anything more than incipient fevers. There is always more or less yellow fever on the Isthmus, for it is native here; it never spreads; we find an isolated case here and there. There was one death from yellow fever at Bohio a year ago, but it was the last. Our laborers earn from $1.50 per day upwards and are paid every two weeks. The amount of drunkenness is no greater than it would be in a similar camp in the States, and good order is maintained. Most of the laborers drink Jamaica rum and it is well known that it is not a bad article.

Everybody from officers to the lowest laborers are provided with a good, comfortable place to live in, and have first-class medical attendance free to all employés.

In regard to the amount of work done, as your Paris correspondent says, things are going ahead well. 1,000,000 cubic meters are being done each month, and within a year it will be doubled, and according to my own figures, which were made two years ago while connected with the *Bureau des Etudes* in Panama, there are to be excavated 113,000,000 cubic meters giving a slope of 1 to 1 in all parts of the canal through dry material, and a slope of 1 to 5 in all swamp lands, so at this rate he work will be completed in four or five years. The dredges in the Chagres bottom are doing well, and I was assured the other day by Mr. Slaven, that they would be able to complete their first seven miles to Gatun within the specified time; there has been no high water in the Chagres since the work was begun, and the stories of the canal filling up as fast as it is dredged are entirely untrue, and the rains thus far have done very little damage, their only effect is to retard the progress of the work. In regard to the statement that the work is over-officered, I will say that it has no more officials than a French company naturally would have; all classified employés are allowed five months' absence every two years, and taken together with the number of those who are sick, it cannot be said this department is overcrowded; it is a well-known fact that the company has difficulty in getting Frenchman to come here, and they only come by the inducement of large pay, as a result the employés are mostly from other nations who would not be given places if they were not needed.

Respectfully Yours,
J. H. CURTIS,
Mem. Rensselaer Soc. of Eng'rs.

The Preservation of Cast-Iron.

The uniform color generally used in covering the unpolished portions of machinery does not present many attractions. This painting is usually done to bring out in stronger contrast the polished metal, to preserve the parts covered from rust and to avoid the spotting of the machines which would detract from its appearance. But if the oxidation of the cast-iron was general, regular and permanent, nothing could be more beautiful, for the red oxide of iron is as agreeable to the eye as the greenish blue oxide that is so much admired in work in copper or bronze. The stability in color of the oxide of iron is no longer a question, the browned barrels of fowling pieces prove this.

The preservation ot this oxide on ordinary machines may be secured as follows: The cast-iron surface is first scraped to remove the scale, dried and then washed with acid. It is next cleaned with a wire brush and rubbed with fat lime. The result will be a wavy appearance, of which one part will be a gravish brown and the other brilliant. Finally wash the surface with raw petroleum, and before it is dry rub with a wire brush.

This treatment gives an invariable surface and an agreeable color. The petroleum prevents spots and softens the tint.—*Moniteur Industriel.*

STATISTICS of the foundry and engineering shops known under the name of Krupp's Works, at Essen, include the following: In 1860 the foundry employed only 1,764 men; in 1870 the number had increased to 7,084; to-day some 20,000 are employed. Reckoning the wives and children of the workmen, there is a total of 65,384 souls dependent upon the enterprise, out of which number 29,000 actually reside in dwellings attached to the works. The number of furnaces in blast is 11, and of other smaller furnaces, 1,542. There are 439 boilers, 82 steam hammers, and 450 steam engines, representing a total of 185,000 horse power. At Essen alone there are nearly 37 miles of railway lines, 28 locomotives, 883 wagons, 69 horses, 191 carts, 40 miles of telegraph line, 35 stations, and 55 Morse instruments.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(Continued from page 82.)

DCLXX. KEESEVILLE, N. Y.

Keeseville, Essex Co., New York in lat. 44° 30′ N., long. 73° 30′ W., is on the Ausable River.

Settled in 1794, it was incorporatd a village in 1878.

Water-works were built in 1883, by the village, after plans of W. H. Lang, taking the supply from the Ausable River, from which, after being filtered through 20 in. of coarse gravel, the water is pumped by two water power pumps — having a combined capacity of 80,000 gallons daily, made by B. S. Nichols & Co. — directly into the mains, giving an ordinary pressure of 60 to 80 lbs. and a fire pressure of 110 lbs. Distribution is by 5 miles of cast-iron pipe of 10 to 4 in. diameter, with 47 fire hydrants, 19 gates and 100 taps.

Service pipes are of iron. The population in 1880 was 2,181. The works have cost $35,000. The bonded debt is $30,000 at 5 per cent.

H. M. Mould, is Secretary and Treasurer of the Board of Commissioners.

DCLXXI. LAREDO, TEX.

Laredo, Texas, in lat. 27° 30′ N., long. 99° 25′ W., the county seat of Webb county, is in hilly country on the Rio Grande.

Settled in 1767, it was incorporated a city in 1848. Water-works were built in 1883 and 1884 by a private company, after plans of W. D. Richardson, the supply being taken from the river. The water is conducted through a 10 in. pipe to a settling well, and is thence pumped by two compound duplex Blake Steam pumps, having a capacity of 2,500,000 gallons each, directly into the mains giving an ordinary pressure of 60 lbs. and a fire pressure of from 90 to 160 lbs.

Distribution is by seven miles of Kalmene pipe of 10 to 4 in. diameter, with 100 fire hydrants, 20 gates, and 100 taps. Service pipes are of galvanized iron. The city pays $75 yearly for each hydrant.

The population in 1880 was 3,521; it is now given as 5,000. The capital sto k of the company is $140,000. The bonded debt is $90,000 at 8 per cent., for 20 years.

The works went into operation in February, 1884. A. L. McLane is President, and Raymond Martin, Secretary.

CORRECTION.—The Pumping Engines of the Hamilton Ohio, Water works are stated by the makers, the Gordon & Maxwell Man. Co., to be "of the Vertical compound condensing Duplex or single acting type with plunger pumps. L. P. Cylinders diameter 40". H. P. Cylinders diameter 20". Pump diameter 17½" Entire stroke 38". Capacity 3,000,000 gallons in 24 hours." The figures given in the description of the Hamilton W. W. on page 70 of ENGINEERING NEWS of August 9, 1884, were furnished by J. D. Cook, C. E.

WATER.

TO THE ADVERTISERS IN CROES' STATISTICAL TABLES.—In accordance with our Contract with Advertisers in Croes' Statistical Tables we have mailed one or more copies of "Tables" to every Water-Works office in America of which we could gain any intelligence. We have sent them to every person whom we could associate in any way with Water-Works interests; we have distributed them among the officials of towns which are contemplating a water supply; our advertisers have distributed extra copies where they "would do the most good," and great care has been exercised in not allowing copies to be wasted. We have some copies still on hand to be sent to parties yet to be discovered. If any of the advertisers in the "Tables" know of *a single* Water Works office in America being unsupplied with a copy, or if they know where another copy can be placed to advantage, and will so inform us, we will mail one or more at once *free of cost*. We want *every copy* to be out and at work for our patrons and ourselves, and the sooner it is accomplished the better pleased we will be.

THE artesian water at Fitzpatrick, Bullock county, Ala., is having its legitimate effects in the rapid improvement of that live little burgh.

JOLIET, ILL., is having much trouble with its system of water-work. The works are owned by a private corporation.

CULIACAN, Sinaola, Mexico, will soon be supplied with water from the river Humaya; work has already been begun on the contract.

THE Boone, Ia., Water Works passed a satisfactory test. Water was thrown 60 to 65 ft. high from the tank pressure, and 100 to 125 ft. high under steam pressure.

BAR HARBOR has just finished a new reservoir. The pipes are nearly all laid and the connection with the old mains will soon be made.

COOTONSVILLE, a thriving suburb of Baltimore, is pondering over the plans and estimates for a system of water-works to cost $30,000, submitted by Mr. J. A. Watson, C. E.

THE pumps at the Flatbush Water Works were injured by the recent earthquake, the disturbance of the water in the stand-pipe producing a species of water hammer action.

THE Artificial Ice Co., of Galveston, Tex., are using Galveston Bay salt water by purifying it. The company has laid pipes 380 ft. off the shore to channel bay to have a sufficient supply.

THE Richmond, Ind., water-works are nearly completed. The water is obtained from artesian wells. It is forced into a reservoir with 5,000,000 gallons capacity and thence distributed over the city.

A SIMPLE method of avoiding the strain and shock produced by the sudden stoppage of water in pipes has been invented by J. Story, of Cincinnati, Ohio. In a branch of the main is a piston backed by a strong spring, the compression of which absorbs the momentum of the water.

THE Mount Vernon, N. Y., Water Works, having met with success in the sinking of their Artesian well, are now erecting a plate iron stand-pipe 10½ ft. in diameter and 85 ft. high. J. J. R. Croes is engineer of the works and Tippett & Wood are the contractors. Pipes are to be laid through the village this fall.

THE Sharon Water Co., of Sharon, Conn., propose a water supply from Birdsley Pond, a distance 13,500 lin. ft., head 225 ft. They invite bids for 8-6 and 4 in. cast-iron pipe and appurtenances up to 8 P. M. Aug. 25. They may also want 500 to 1,000 lin. ft. of 10-in. pipe. Address W. E. Pettee, Engineer, or J. M. Bartram, Superintendent.

DURING the month just closed there were pumped into the city water mains of Duluth, Minn., 17,577,280 gallons of water, or an average per day of 405,718 gallons. Pumps were worked 368 hours during the month, and this amount of water was raised with the expenditure of 50 tons of coal. In June 8,669,888 gallons were pumped, and in May 4,250,000 gallons. Such an increase in three months is something remarkable.

BARON VON MUELLER has sent to the Victorian Water Supply Department a long report as to the powers of the eucalyptus tree to absorb water, and to condense into water the moisture in the air. He speaks highly of the remarkable powers of these trees in this direction as well established, and urges judicious tree planting as an auxiliary measure for maintaining and augmenting the water supply.

NEW YORK, Aug. 19.—The officials composing the Boston Water Board arrived here this morning. They are Henry M. Wightman, City Engineer; Aldermen Greenough, Harvey M. Collison, Edward Finnerty, Wm. Taylor, Jr., Samuel Hichborn and Geo. M. Hobbs. Their mission to New York is to study the system of water rates here, and put them in practice in Boston. Engineer Wightman said they wished to adopt a sidewalk stop-cock of some kind, To-day the board will visit the Croton Water Works and confer with the Water Board.

IN the report of the water department of St. Louis, it is stated that the inspection of water waste during the time it was enforced, saved to the city 18 per cent. in the night, and 15 per cent. in the day of the water pumped. The board, however, believes the general introduction of meters preferable to inspection. But if the prejudice against meters is too strong to admit of their use in the manner proposed by the board the latter would strongly advocate a thorough system of inspection; for, even if considerations of economy should be left out of the question, the inhabitants of the higher portions of the city, have a right to demand that their supply shall not be diminished by the culpable wastefulness of people located so as never to suffer from shortness of supply, while in a position to do great injury to their fellow-citizens living on high ground. An appropriation of $420,000 is asked to be used in extending the distribution system of the Water-works.

THE village of Johnstown, N. Y., derives its water supply from damming a stream called Cold Brook, and conducting the water through conduits to a distributing reservoir. The dam being of timber on a quicksand formation leaked badly, and the line of 8 in. pipe leading to the distributing reservoir followed the surface of the ground and having several points above the hydraulic grade line, failed to deliver all the water which came to the inlet chamber. As a consequence the supply was insufficient. The improvements recommended by J. E. Babcock, hydraulic engineer, and afterwards undertaken and completed by him under a contract for the sum of $7,067,00 were as follows: The construction of a new stone dam about 100 ft. below the old one with foundations reaching to the bottom of the quicksand with a small receiving pond, paved over with stone laid in cement, the saddle of the dam only of the elevation of the water in the creek as it then stood; the required depth of pond, about 3 ft. being obtained by excavating below creek bed. An open conduit was then laid for 1,200 ft. from the pond, in order to collect the water from a series of springs. This was continued in a line of 12 in. vitrified pipe, until, reaching a point from which the fall to the distributing reservoir was 90 ft. an 8 in. pipe was substituted. Under this arrangement 550,000 gallons per diem are delivered, against 228,000 under the old state of affairs.

NEWS OF THE WEEK.

Miscellaneous.

ST. LOUIS has 316 miles of improved streets, 203 of which are macadamized.

WITHIN two weeks Omaha will have a complete and connected system of street and alley pavement covering the business portion of the city.

THE Taylor avenue bridge, St. Louis, will be completed before the close of the year, and all appropriation for the commencement of the Grand avenue bridge is asked.

THE report of the City Surveyor to the Common Councils of New Orleans says that the State engineers have laid a line for a new levee above Carrollton, and recommend that a new levee be built from Upperline down as far as Hilary street, which would cost $30,000.

THE contract for building a bridge over Salem Creek, at Salem, N. J., consisting of one draw span 135 ft., and two fixed spans 112 ft. each, was awarded H. G. Welty, Secretary Cleveland Bridge & Iron Co., on Aug. 13th, for for $21,493. Bidders present, King Bridge Co., Wrought Iron Bridge Co., Riverside Bridge Co., Phœnix Bridge Co., Dean Westbrook & Krause, Berlin Bridge Co,, Central Bridge Co. and Penn Bridge Co.

THE dome of St. Peter's Rome, has been recovered with lead. The work has occupied twelve years, and has cost over 200,000 lire (8,000*l.*) The orginal covering was applied to the dome in an imperfect fashion, which made repairs a necessity; and at last it was determined to strip off the whole envelope and substitue a new one on a better system. New lead was imported from Spain and mixed with the old lead, in proportion of one part old to two parts new. The total weight of the new cover is given at 354,305 kilograms; and if it were spread out flat it would occupy an area of 6,152 square metres, or about an acre and a half. In stripping off the old plates, three of them were found to be of gilded copper.

THE cost of electric light for the illumination of cities, as compared with gas, has been computed by Hartford, Conn., where arc lights have been in use for about a year. The report states that each electric light in use displaces six and one-half street burners, besides giving at the same time at least ten times as much light. The gas lamp costs $35 per burner per annum, kept burning 328 nights in the year, while for the electric lights 65 cents a night is paid. The electric light being equal to six and one-half gas burners, a saving of $15.60 per lamp per year is effected by the use of electricity, besides the cost of lighting and extinguishing the gas lamps.

THERE is being built for the Health Department of the City Government a species of marine ambulance, a light, swift steamer specially designed for the purpose of removing the sick from vessels in the harbor to the hospital. Her dimensions are, length 100 ft, breadth 19 ft. 3 in., depth 9 ft. 2 in., displacement 183 tons. The engine is vertical, high pressure, 22 × 22 cylinder and 350 horse power. She has return flue boilers 8 ft. 6 in. in diameter, and 12 ft. 6 in. long, designed to work at 110 lbs. pressure. Grate surface 42 sq. ft., heating surface 1260 sq. ft. Her screw is 7 ft. 6 in. in diameter, of 11 ft. pitch and will drive her through the water at a speed of fourteen miles an hour. She has a wooden hull built of eleven and twelve year woods, and on the main deck are a number of airy, roomy state-rooms containing cots for the sick during transportation. Mr. Wm. Cowles, 111 Broadway, is the designer.

MOBILE, ALA., August 12.—Bids for harbor dredging were opened to-day by Maj. Damrell, as follows: Mobile Harbor—Tobias Burke, 9 cents; Rittenhouse Moore, 10 cents; James E. Slaughter, 10½ cents; Geo. C. Fobes & Co., 11½ cents; S. N. Kimball, 12½ cents; American Dredging Company, 14 cents, and Benson & McNeill, 15 cents. For Pensacola— James E. Slaughter, 74½ cents; Geo. C. Fobes & Co., 90 cents; Rittenhouse Moore, $1.05; S. N. Kimball, $1.22½; Tobias Burke, $1.24.

STOCK for a new Atlantic cable is stated to have been largely subscribed for in Copenhagen. It is proposed to start from Thurso, in Scotland, from there to run to the Faroe Islands, thence to Iceland, and from Iceland to the west coast of Greenland. From this latter point the cable would dip southward to Lawrence Bay, striking the American continent finally at Gaspe Harbor. The length of the cable is 3,150 miles. The longest section will, however, be under 900 miles in length, and it is anticipated that for that reason it would do the work of any two of the cables now uniting Europe with America.

THE Keystone bridge company propose to have the new C. I. St. L. & C. bridge over White river in position by Oct. 1. This establishment is highly prosperous. The orders now booked will keep the works running over a year. Every department of their extensive plant is in full operation. About 550 men are now employed. Work is progressing rapidly on the new bridge for the Louisville & Nashville Railroad Company, to be erected at Henderson Ky. Work is about to be commenced on the railroad bridge which is to be put up at Port Deposit, Md., for the Baltimore & Ohio Railroad Company, and on the Logansport bridge, for the Vandalia line. This bridge will be 597 ft. in length.

A NEW channel for engineering talent has been discovered in Texas, namely, hunting for buried treasure left by pirates. A joint stock company has been formed and the services of several engineers employed to drain Hendrick Lake, 15 miles from Marshal, Tex., for the purpose of recovering the money and jewels with which the bottom of said lake is popularly supposed to be paved. As the lake is a mile long and 200 ft. wide, the yield would have to exceed that realized from numerous raids on the cash deposits of the historic Capt. Kid, to ensure very large dividends on the capital stock.

MR. WILLIAM L. LOWRY, of Boston, has invented a process by which he claims the possibility of extracting 50 per cent. more power from a given amount of fuel in the use of steam boilers. Ten per cent. of methylic spirits, or pure wood alcohol is mixed with the water, resulting in a lowering of its boiling point to 160 degrees Fah. A coilcondenser is used and the mixture is returned to the boiler and used again. An incidental advantage is the ability to get up steam in one-half the time generally required. The method is in use in several manufactories in Boston and a series of expert tests of it are in progress at the Washington Navy Yard.

THERE have been, thus far, 178 applications for space at the Philadelphia Electrical Exhibition. The Belgian Government has made known its intention of contributing its collection of works on electricity. The first telegraph instrument ever used to send a message will be on exhibition. Close beside this key will be the latest improved synchronous multiplex machine, by which seventy-two messages can be sent over the same wire at the same time. The Committee on Bibliography announces that it has already received contributions of at least 3,000 titles to the Memorial Library. Seventeen parcels of electrical works of various kinds have just been shipped from Paris by M. Leopold Boesarge, and a number from London, by Frederick Ransome, Esq., representing the institute in those cities.

A NEW thing in marine work is a species of floating coffer dam. Its use is in the repair of vessels which are damaged either at bow or stern. When it is remembered that at least nine-tenths of all marine mishaps occur at these points of a vessel, it will be seen that its field of usefulness is large. Nearly half of the accidents occurring are about the propellor and rudder post. Heretofore when such an accident was at all serious the repair bill has been very burdensome both in direct expense and in the delay. Such repairs were necessarily made in dry dock, which necessitated the shifting and storage ot cargo meantime. The floating coffer dam is nearly square in shape, and is constructed throughout of the best hard pine lumber. It is 35 ft. long, 32 ft. beam at the gate end, and 28 ft. beam at the closed end, while its depth is 24 ft. It will thus be seen that its construction must be sufficient to stand the enormous strain of 24 ft. head of water. It is flat on the bottom and three sides are as square as a box. The gate side is built V-shaped half its height, while the upper half of the vast inclosure is shut in by huge gates, which swing on massive hinges and are so arranged as to offer no obstruction to a ship's propellor.

The dam is towed alongside the injured vessel and sunk at either bow or stern, as the case may be. It is then fitted to the vessel so that the keel rests upon the bottom timbers of the dam and the vessel's sides fit into the V-shaped open end. Planking and layers of felting are fitted around the vessel, which is thus made to form the fourth side of the coffer dam. The dam is then pumped out, and being relieved of its immense weight of water lifts the end of the vessels out of the water and leaves the injured portion as high and dry for repairs as if it were in a dry dock. It has the advantage over a dry dock that in cold weather it can be temporarily roofed over and heated so that it will serve all the purposes of a workshop. This is an important consideration in the repair of iron vessels in the winter season.

Railroads and Canals.

ABOUT 30 miles of grading and 10 of tracklaying have been completed on the Minneapolis, Sault St. Marie & Atlantic railroad.

FOUR new street railway companies have petitioned the New York aldermen for the right of way,

WEST CARROLL PARISH, LA., wants a railroad running through there connecting with St. Louis and New Orleans. A committee have been formed to correspond with capitalists.

WORK on the Texas, Sante Fe and Northern, from the terminus of the Denver and Rio Grande at Espanola, to Sante Fe will commence Oct. 1st.

THE Cape Girardeau Southwestern Railway connecting with the St. Louis, Iron Mountain and Southern line at Delta, celebrated the completion of its first thirty-eight miles of track recently.

SAN FRANCISCO, Cal., Aug. 15.—W. W. Belden, of Boston, reports that the funds necessary to complete the canal connecting Lake Washington with Puget sound have been raised, and that work will soon commence.

Engineer McWilliams is ready to begin work on the incline of the St. Louis and Cairo Railroad below the depot of the road, and to lay out the new line of road into the city over the right of way recently obtained, and which will be raised by filling or trestling to fifty-five feet by Cairo water-gauge, and made permament.

WORK was commenced on the Memphis, Selma & Brunswick railroad several years ago but stopped, after 20 miles of rails were laid, on account of financial embarrassment. A receiver has now been appointed, with power to issue certificates of indebtedness and complete the road between Memphis and Holly Springs.

THE following roads and extensions are now being constructed by the St. Louis & San Francisco road: Bolivar Branch—Springfield, Mo., to Bolivar, Mo., 40 miles to be completed September 1st, 1884; gauge, 4 ft. 8½ in. Arkansas Division Extension—Ft. Smith, Ark., to Paris, Tex.; expected to be completed during 1884; gauge, 4 ft. 8½ in.

Two or three years ago Wm. Collier, of Port Dover, obtained a charter for a new road to run virtually in opposition to the Canada Southern. An extension project has been entertained, and the road is now named Port Rowan and Lake Shore and Port Royal and Detroit River. A line is now under survey from Buffalo to Windsor.

IT is proposed to undertake new railway works in France next year to the extent of 7,520,000*l.* Of this proposed expenditure 4,000,000*l.* will be at the charge of companies, and 3,520,000*l.* will be at the charge of the State. The aggregate expenditure proposed to be made this year is 7,640,000*l.*, of which 2,840,000*l.* will be at the charge of companies and 4,800,000*l.* at the charge of the State.

AUSTIN, Aug. 15.—The Texas Midland Railway Company was chartered to-day with a capital of $500,000. The road commences at Waco and extends to a point on the east boundary of the State, about 25 miles south of Shreveport to Panola County, and runs through the counties of Limestone, McLellan, Freestone, Anderson, Rusk, Cherokee, Nacogdoches and Panola. The incorporators are Peter McClellan, Sr., Peter McClellan, Jr., T. C. McGregor, George Clark, W. A. Taylor, J. W. Mann, J. A. Downs, D. J. Wood, W. M. Peck, C. L. Watson and S. D. Bradley.

WORK was commenced on the Lima & Columbus road. The road will connect at Lima with the Chicago & Atlantic and the Fort Wayne for Chicago, and will go over the Dayton & Michigan to Toledo.

MR. E. A. GARVEY chief engineer of the Texas and Pacific road. has just finished a survey of a "cut-off" from Woskom, Tex., to Reisor Station, La., a distance of about ten miles, which will be built within the next ninety days.

THE Georgia Midland & Gulf Railroad is proposed to connect Atlanta and Columbus. The company was chartered last March under the law regulating the incorporating of railroads, with a capital stock placed at $1,000,000.

HARRISBURG, Pa., August 15.—A charter was issued to-day to the Eastern and Western Air Line Railway Company, which intends building a road from Lawrence to Jefferson county, 112 miles long. The capital stock is $5,600,000. Waldorf H. Phillips, of New York, is credited with the ownership of 22,364 of the 23,000 shares.

THE San Joaquin Valley Railroad Company, which was incorporated under the laws of California last winter, has just finished its first survey of 125 miles of line, through which it has secured the right of way. The survey is made from Antioch, in a southeasterly direction, on the west side of the San Joaquin river.

THE graders of the Jacksonville, Tampa and Key West Railroad are at work just west of Orange City finishing the grading between Beresford and Thrasher's ferry. This will be completed within a few weeks, then all grading will be completed for the road, except from Thrasher's ferry to Sanford.

INDIANAPOLIS, IND., August 11.—Thomas B. and James A. Inners, L. C. Twomley, Thomas S. Stanfield, Andrew Anderson, J. C. Knoblock, Robert Myler, A. Coquillard and Thomas G. Ream to-day filed articles of incorporation of the South Railroad Company. The road is to be a belt line and will connect with various roads passing through South Bend.

MANAGER NETTLETON, of the Fort Scott & Gulf Railway, who has already pushed the building of a road from Kansas City via Springfield to Memphis, Tenn., has now two or three corps of engineers in the field for the purpose of ascertaining the most practicable route from a point on his own road in the neighborhood of Ochiltree, via Clinton, Osceola, Stockton, Humansville and Bolivar to Springfield.

THE Vicksburg *Herald* says: There are now employed in the construction department of the Louisville, New Orleans & Texas Railroad, between Harrison and Leland, over one thousand men. The gap in the road between Vicksburg and Memphis has been reduced to 22 miles. The present arrangement is to have the road completed by the first of September and put in through trains from Memphis to New Orleans by the 15th of that month.

THE Reading and Lebanon Railroad Company is supposed to be a part of the Pennsylvania Railroad system, and will connect with that company's road at Reading. It will cover 30 miles. Engineers will be put to work at an early day. The road, it is understood, will run almost parallel with the Lebanon Valley branch of the Philadelphia and Reading road. It will touch Sinking Spring, Wernersville, Robesonia, Womelsdorf, Richland, Sheridan, Myerstown and a few other points, and stop at Lebanon for the time being.

THE latest "drive" on the Mexican Central is a story going the rounds to the affect that its passenger service is being employed as a dueling instrument by the natives. The injured or insulted party challenges his enemy to a ride upon the road, and one or the other of them is almost sure to be maimed for life if not killed outright. Of course the occurence of a catastrophe affecting either party obsolves the other from a further continuance of his ride, and he walks home with his "honaw" satisfied.

THIS is a day of phenomenal activity in the line of novel ideas in street railways and motors. The United States Cable Road and Subway Company is the name of a corporation holding patents on a new system of railway of which the following is the leading feature. The tracks are laid in tunnels under the pavement, and the wheels running on them are connected with the car above by a steel plate, ½ in. thick, which moves along through a slot in the roadway. Advantages claimed: Unimpaired smoothness of road surface, ease of entering and leaving cars, due to the fact that the floor of the car is only four inches from the ground, and the impossibility of running over anybody, resulting from the same feature.

ABSTRACT of proposals for dredging, in the harbor at Baltimore, opened at 12:5 P. M., August 11, 1884.

No.	Name.	Address.	Price per cu. yd. ¢	Quantity bid for.	Remarks.
			16¾	All, or	
1	Morris & Commings D. Co.	New York.	14	Craighill channel	
			15	Brewerton.	
				100,000 yds in	
2	N. Y. Steam Dredging Co.	" "	13½	Craighill.	
3	American " "	Philadelphia.	15¾	All	
			25	100,000 yds. in cut off.	
4	D. Constantine.	Baltimore.	12	200,000 yds. in Ft. McHenry.	
5	Geo. C. Fober & Co.	"	11¾	All of Craighill or	
			12¾	Brewerton, or	
			17¼	Ft. McHenry or	
			23½	350,000 from channel to channel in cut off.	
6	Thos. Potter.	Jersey City.	19¾	500,000 yds. in cut-off.	
7	Atlantic Dredging Co.	Brooklyn, N. Y.	19½	All.	
			11⅞	Craighill.	
8	National " "	Wilmington, Del.	20	Cut-off.	
			12⅝	Brewerton.	
			19	Ft. McHenry.	
			16½	All.	
9	Ross & Sanford.	Jersey City.	11¾	Craighill.	
			21⅝	Cut-off.	
			13⅝	Brewerton.	
			17⅞	Ft. McHenry.	
10	Edward Moore.	Portland, Me.	23	Cut-off.	
			16½	All.	[clam-shell dredge.
11	Thos. P. Morgan.	Washington.	16	Ft. McHenry.	Material that can be worked with
12	Henry DuBois Sons.	New York.	26	Ft. McHenry.	For all hard material requiring
			10⅜	Brewerton.	dipper dredge.
			10⅜	100,000 from Craighill.	Provided all bid for is awarded.
			10⅜	100,000 from Ft. McHenry channel west to Brewerton.	
13	Benson & McNee.	San Francisco.	23¼	Craighill and Brewerton.	

THIRTY miles of rails have been laid on the Wisconsin, Minnesota and Pacific road, and the remaining 95 miles to Watertown, Dak., are going down at the rate of two miles a day. Engineers are still engaged in making preliminary surveys beyond Watertown.

AT a late meeting of the corporators of the Lynchburg & Southwestern road, Capt. Izard, the engineer engaged to make a preliminary survey, presented his report giving the length of the proposed line from Lynchburg, Va., to a point in Ashe County, N. C., as 176 miles. He estimated the cost of the grading at about $8,500 per mile.

THE survey of the Illinois Southern and Paducah is now nearly completed. The projected line will cross the Ohio River at Metropolis, Massac County, Ill., connecting with the Chesapeake & Ohio at Paducah, Ky., and run northwest from Metropolis to St. Louis. The road will pass through Massac to Vienna, the county seat of Johnson County, and thence through northwest corner of Union County to Carbondale, Jackson County, and thence continuing northwest to Murphysboro, the county seat of Jackson County, reaching the Mississippi River a little south of Rockwood, in Randolph County; continuing along the river bank to Chester, the road will run through the Okaw River Valley to Evansville, where it will cross the Okaw and run north to Ruma and Red Bud, and there cross the St. Louis & Cairo road, and thence will run north to Freedom, Monroe County, and from there to Georgetown, St. Clair County, passing through the famous High Prairie coal field, thence west to the Mississippi, at East Carondelet; from there follow the river to the Relay depot, in East St. Louis.

"FUNNY SIGHTS?" said an eastern railroad employee yesterday, "Well, rather. There are more funny incidents of all kinds, I believe in connection with railroading than any other business. And the questions people ask us!".

"A stout, red-faced woman, carrying a large basket and several bundles, came along the other day and asked what time the next train went to Gloucester. I told her '10:50.' 'An' what the divil's time is 10 minutes past 50?' she asked. I was obliged to explain my meaning and came near laughing in her face.

"The boys sometimes get off good things on people that ask foolish questions. A countryman came up to one of our conductors the other day, in Portland, and said, 'Does this train stop at Boston? If it does not, 'he said, 'you'll see one of the d——smash-ups you ever saw.' The countryman looked kinder startled, but got aboard.—*Boston Globe.*

CHIEF ENG. JOHN S. TITCOMB writes us that the Wyoming Development Co. have finished the grading on their Irrigating Canal No. 1 for twenty miles, being 25 ft. wide at standard grade for sixteen miles, then 22 ft. wide for two and one-half miles and 20 ft. wide for the remaining one and one-half miles. The carpenters' gang are now driving piles and putting in dam, head-gates, flumes, highway bridges, etc. Canal No. 2 has been located for nine miles and some grading been done near its head. The tunnel described by Mr. C. A. Miller, formerly assistant to Chief Titcomb is under contract to Mr. C. A. Deane, of Denver, is now in 300 ft. in very hard gneiss.

THE project for constructing a ship canal across Ireland has been warmly espoused by influential people in England. Elaborate plans and surveys have been made at considerable expense, and have been submitted by Capt. Eads, the American engineer. The plans were prepared by Mr. T. A. Walker, of Great George street, Westminster. The proposed canal would be 127 miles in length, and would contain thirty locks. For ships of 1,500 tons the cost would be eight millions; for ships of 2,500, twelve millions, and for ships of 5,000 and upward, twenty millions sterling. If built on this scale, the canal would be 200 ft. wide on the surface and 100 ft. at the bottom. The passage through the canal would be effected by a system of towage, and it is estimated that the passage of a ship from Galway Bay to Kingstown would occupy between twenty-four and thirty-six hours. An alternative scheme of a ship railway, in which the ships would be carried in cradles, which could be constructed for ten millions, is proposed, by which the duration of the passage through the island would be reduced to twelve hours. An immense aqueduct would have to be constructed to carry the canal over the Shannon at Banogue, and would be over three miles in length, being one of the most difficult and costly works in connection with the undertaking.

THE editor of the Ponca, Neb., *Journal* tells how they used to travel on the narrow-guage railway between Sioux City and Ponca a few years ago. He says: "The narrow gauge went up and down hill, so much so that when climbing the grade near the summit the shrieking struggling little engine found it difficult to make headway. In those days the genial conductor always regarded the few passengers as guests, and treated them accordingly, and when the train went up hill, and the engine gave a howl of despair, would get off and push behind. These were the halcyon days of railroading. We recollect going down from Ponca to Jackson one day. We were the only passenger—frequently the train had no passenger at all. Below the summit we saw a man in the field plowing. He owed us on subscription. Being short of bankable funds we desired to hold a short *seance* with him. We stated our desire to the conductor. Did he turn a deaf ear to us and whip up the train? No. He jerked the cord and stopped the train and we went and dunned the man. During our absence the conductor went to the creek and fished. Those were the pastoral, the joyful, the inimitable, days of railroading. The like we shall never see again."

Army and Navy Notes.

IN speaking of our coast defenses, so called, General Newton says: "There is nothing in the reports this year that has not been known a long time, they show the utter defenseless condition of our coast, and the impossibility of repulsing an attack by the navy of any second or third European power. The defenses of Washington form the most striking example though no worse than many others. Here is the national capital, the capitol building, and that important institution called the treasury, protected by two dismantled, decaying and superannuated forts that are utterly useless. It is certainly to be hoped that congress will realize the necessity for improving this state of affairs. It seems particularly urgent that Washington should be properly protected."

THE joint Congressional Committee on Ordnance began its inquiry Wednesday into the capacity and facilities of the United States for producing steel for guns and ships. Senators Hawley, Aldrick, Morgan and Butler, and Representatives Phelps, Hissock and Randall were present, and two sessions were held, one in the forenoon and one at night. The first session was largely occupied with informal discussion of a plan of operations, and the reading of a number of communications calculated to instruct the committee as to the capacity and methods for steel production. Letters were received from the Cambria Iron Works, of Johnston, Pa.; Briar Hill Works, Youngstown, Ohio; Pennsylvania Steel Co., of Steeltown, Pa.; Standard Steel Casting Co., of Thurlow, Pa.; West Point Foundry, of Cold Springs, N. Y.; Tredegar Iron Works of Richmond, Va. John Roach talked to the committee concerning steel and its manufacture. The committee accepted an invitation to visit the Morgan Iron Works to witness the working of a large steam hammer. They will also go to the ordnance testing ground at Sandy Hook. Yesterday A. H. Emery, of Watertown, Mass., gave at length his experience and knowledge of steel works and guns and the cost of manufacturing them.

DISMANTLING THE GUNS.—About 120 old-style muzzle-loading 58-caliber Springfield rifles are now dismantled at our armory daily, and such parts as fit the new breech-loading model are reused. The guns thus taken to pieces are part of the 500,000 old-style rifles made at the armory during the war and stored there unused after 1865. The dismantling began in 1868, when it was found that the whole gun could be sold in the market for only $1.50, while the parts which could be used in the new model, together with the sale of the remainder as scrap-iron to shot-gun makers, would net the government about $4.

The parts sold are mainly the stock and barrel and scrap material, and most of these parts go to manufacturers of cheap shot-guns. The Whitney company, of New Haven, and the Remington company, of Ilion, N. Y., are large buyers. The 50-caliber rifles, which were first made in 1866. of which only 50,000 were manufactured, were never stored, but went at once into active service, and have been mainly worn out in it. There are now stored at the armory about 50,000 of the 58-caliber model, and 158,000 dismantled barreis and 128.000 stocks. About 50,000 "cleaned and repaired" 58-model rifles are also stored, but will not be dismantled, as they are mainly contract guns and have seen such rough service in the field as to make it inadvisable to use their parts in new rifles.—*Springfield Republican*

PROPOSALS.

Improving Cape Fear River below Wilmington, N. C.

PROPOSALS FOR DREDGING.

U. S. ENGINEER OFFICE, 70 Saratoga Street,
BALTIMORE, MD., July 24, 1884.

PROPOSALS for Dredging in Cape Fear River, N. C., will be received until eleven o'clock A.M., August 28, 1884, and opened immediately thereafter.

Blank forms, and specifications can be had upon application to this office.

WM. P. CRAIGHILL, Lt.-Col. of Eng'rs, U. S. Army.
5-4t

Improving Cape Fear River below Wilmington, N. C.

Proposals for Furnishing Stone.

U. S. ENGINEER OFFICE, 70 Saratoga Street,
BALTIMORE, MD., July 24, 1884.

PROPOSALS for furnishing 30,000 tons of Stone for the improvement of the Cape Fear River, North Carolina, will be received until noon August 28, 1884, and opened immediately thereafter.

Blank forms and specifications, etc., can be had upon application to this office, or to the resident Engineer, Mr. HENRY BACON, at Wilmington, N. C.

WM. P. CRAIGHILL, Lt.-Col. of Eng'rs, U. S. Army.
5-4t.